BROOKLYN BOTANIC GARDEN

LEAFLETS

SERIES X BROOKLYN, N.Y., APRIL 5, 1922. NO. 1

ARBOR DAY

"When we plant a tree, we are doing what we can to make our planet a more wholesome and happier dwelling place for those who come after us if not for ourselves."

—OLIVER WENDELL HOLMES.

The significance of Arbor Day, I find by questioning various intelligent citizens, is shrouded in a certain mystery and vagueness. Somewhere, somehow, someone plants trees. It has something to do with the schools and school children, and the day itself may be ordained by civic or governmental authorities after some inscrutable standard of their own.*

But this unenlightenment exists for the most part among the present older generations, for most of whom the institution of Arbor Day was just beginning in their schooldays. Hardly a boy or girl of the younger generation today but knows the meaning of this festival and has assisted in the performance of its ceremonies.

HISTORY OF THE ARBOR DAY MOVEMENT

The history of the development of the Arbor Day movement begins with its first celebration in Nebraska as early as 1872. Later in the seventies, three other states, Kansas, Tennessee and Minnesota, gave their official approval; in the eighties the wave of enthusiasm reached thirty more states; in the nineties, eight more, and nearly all of the others since 1900. Thus we see a gradual overspreading of the institution throughout the country until now it is celebrated almost universally in the United States and its territories and also over a large portion of the rest of the civilized world.

The idea originated in Nebraska, where, in common with other states in the Great Plains area, the first settlers sorely felt the lack of trees with all their accompanying benefits, such as timber for houses and fences, shade in the hot summers, and protection for orchards, field crops, and buildings from the high winds that sweep over that flat country. As a consequence, tree planting early became popular although haphazard. In 1872, at a

* Possibly the name might be a little misleading, for we have in English two "arbors"; one derived from the Latin and signifying "tree," used in Arborvitae, or Tree of Life, and similar botanical names. The other word is connected with the English "herb" (colloquially yarb or arb), which, although originally denoting a grassplot or lawn, has come to mean a bower or a place sheltered by green leaves or vines above (e. g. grape arbor). It is of course the first meaning that is used in Arbor Day or Tree Day.

meeting of the State Board of Agriculture, Mr. J. Sterling Morton, afterward United States Secretary of Agriculture, introduced a resolution setting apart a day for general tree planting throughout the state. The resolution was adopted and prizes offered for those who planted the greatest number of trees. "Wide publicity was given to the plan and over a million trees were planted in Nebraska on that first Arbor Day. In 1874, Governor Furnas, of Nebraska, by public proclamation, set aside the third day of April as Arbor Day, and in 1885 the State Legislature passed an act designating the birthday of Mr. Morton, April 22, as the date of Arbor Day and making it a legal holiday."

Since the first Arbor Day in Nebraska nearly a billion trees have been planted in that state, covering over 700,000 acres, so that in contrast to its original bare, treeless condition, it is now known as the Tree Planters' State, this name having received the sanction of the legislature by an act passed April 4, 1895.

The State of Kansas, where the natural conditions were similar, followed Nebraska in 1875, with Tennessee in the same year. Minnesota, whose lands were being rapidly devastated of their valuable white pine forests, came next in 1876.

Thus far Arbor Day has signified a tree planting bee and nothing else, but in 1882, at Cincinnati, Ohio, two new elements were introduced, one educational, and the other ceremonial, both of which transformed its functions into a more dignified festival, and were largely responsible for its rapidly increasing observance throughout the country in the eighties. Up to this time the tree planting had been carried on under the auspices and fostering efforts of town authorities and agricultural associations. Now the propaganda was carried to the schools, and on this first Arbor Day of Cincinnati, "about 20,000 children participated in the singing and reciting" and in planting the trees. Tree planting now became a festival combining utility, instruction, and patriotism, as well as pleasure; and "one of the greatest benefits of the observance of Arbor Day has been its effect in impressing upon the minds of the young people the value of trees and the necessity of conserving all the natural resources of the country."

What is the history of the day in New York State? In 1888, too late for its observance in that year, the law was passed designating the Friday following the first day of May as Arbor Day.* This law was approved by the governor, April 30, 1884, and reads in part as follows:

"An Act to Encourage Arboriculture" Chap. 166.

The people of the State of New York, represented in Senate and Assembly, do enact as follows:

Section 1. The Friday following the first day of May in each year shall hereafter be known throughout this State as Arbor Day.

2. It shall be the duty of the authorities of every public school in this State to assemble the scholars in their charge on that day in the school building, or elsewhere as they may deem proper, and

* This year, for various reasons, April 21 has been appointed as the date of Arbor Day in New York City, by the Superintendent of Schools, and approved by the State Commissioner of Education.

and to provide for and conduct, under the general supervision of the City Superintendent or the School Commissioner, or other chief officers having the general oversight of the public schools in each city or district, such exercises as shall tend to encourage the planting, protection, and preservation of trees and shrubs, and an acquaintance with the best methods to be adopted to accomplish such results.

Accordingly, in 1889, and thereafter, the observance has been general throughout New York State.

Practical Methods for Observance in the Schools

I have sketched the way in which Arbor Day has developed from the mere planting of trees to an institution with important educational features, so that, as now constituted, it offers unusual opportunities for the awakening in the hearts of our boys and girls a love of nature and a realization of civic and patriotic duty. And so the day ought to be eagerly welcomed and utilized to the fullest extent by teachers in every community.

Formal exercises, such as speeches, readings, and songs, are, of course, not indispensable, but they lend a greater dignity to the occasion and leave probably a more lasting impression. But by all means the main principles relating to the life of a tree should be explained as simply and as clearly as possible, such as the way it grows, what kinds of food it requires and how it gets them, how it breathes, whether or not it feels, and, in short, how it is a living being distantly akin to ourselves. The necessity for conserving our forests, and in fact, all natural resources, so that citizens of future generations may not be deprived of them, should be particularly emphasized. In this connection the value of trees and forests for timber and forest products may be discussed, as well as their importance in regulating stream flow, preventing erosion, and acting as barriers to break the force of the wind. The whole subject may be brought into line with an appeal to patriotism, the spirit of which we must implant in the hearts of our future citizens. Therefore, the custom is particularly commendable of dedicating trees or groups of trees to great statesmen and patriots, and now especially since the last great struggle, to those who made the supreme sacrifice and to those also who offered their lives.

The aesthetic side should also not be neglected. What a dull place would our land be without the trees! Contrast glaring city streets and bare country with long, cool avenues of magnificent stately trees and a landscape clothed with a mighty forest.

It would seem to be the best plan to talk over these subjects with the pupils from time to time as the day approaches in order to gradually arouse an interest. The kind of tree to plant, the site and method of planting should also be discussed. When the day arrives, one of the older pupils might read an essay on the history of Arbor Day, preferably composed by himself. The following references will be found helpful for such work:

1. Arbor Day Annual. Bulletins on Arbor Day issued by the State of New York Education Department, 1900-1913. Albany.

Several other states and some cities issue, each year, special pamphlets on Arbor Day.

2. Egleston, N. H. Arbor Day: Its History and Observance. 80 pp. U. S. Dept. of Agriculture, 1896.

3. Everard, L. C. Arbor Day. 23 pp. Dept. Circular 8. Contrib. from the Forest Service, U. S. Dept. of Agriculture, 1919.

4. Schauffler, R. H. Arbor Day: its history, observance, spirit and significance; with practical selections on tree-planting and conservation, and a nature anthology. 360 pp. Moffat, Yard & Co., New York, 1909.

5. Skinner, C. R. Arbor Day Manual. An aid in preparing programs for Arbor Day exercises. 456 pp. Albany, 1890. Weed, Parsons & Co.

As regards the kind of tree to plant, it is obvious that the selection of native species is more in harmony with the Arbor Day idea. But it is an unfortunate fact that scarcely any native species thrive under the difficult environmental influences of a crowded city. However, this is less applicable to the conditions in the suburbs and the school grounds. The following list emphasizes native species wherever possible:*

FOR NEW YORK AND VICINITY

City Streets

1. Pin Oak.
2. Oriental Sycamore.
3. Norway Maple.
4. Gingko.

Suburban Streets

5. American Elm.
6. Red Oak.
7. Sugar Maple.
8. Red Maple.

Also Nos. 1-4.

School Grounds

9. Tulip.
10. American Linden.
11. Sweet Gum.
12. Beech.
13. Flowering Dogwood.
14. Red Pine.
15. White Pine.
16. Blue Spruce.
17. Magnolia sp.

Also Nos. 1-8.

This year is the 50th anniversary of Arbor Day. Since its inauguration we have passed safely through many crises, of which the last threatened to jeopardize the cause of liberty throughout the world. Let us all therefore make every effort to celebrate the occasion with proper spirit and a sincere thankfulness to the providence of God. Too many demoralizing influences are at work these days among our young people, and young minds are far more plastic than in later years. Nothing is more wholesome than a love of nature, and a child who has an interest in trees and flowers can never go far wrong. We can each year contribute to good citizenship and a clean moral tone throughout the country by a serious, thoughtful, and appropriate observance of Arbor Day.

A. H. G.

* For details as to methods of planting, see TREE PLANTING, Brooklyn Botanic Garden Leaflets, Series II., No. 3, April 22, 1914.

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CHILDREN'S NUMBER

BROOKLYN BOTANIC GARDEN

LEAFLETS

SERIES X BROOKLYN, N.Y., APRIL 19, 1922. NO. 2

NINTH ANNUAL GARDEN EXHIBIT FOR BROOKLYN BOYS AND GIRLS

Time—The ninth annual Garden Exhibit for the boys and girls of Brooklyn will be held September 29 and 30. The exhibit will be open to the public from 2 to 5 p. m. on the 29th, and from 10 a. m. to 4 p. m. on Saturday, the 30th.

Place—Our exhibit will be held in the central rotunda of the laboratory building, at the Botanic Garden. The building may be entered either from Washington Avenue, No. 978, or from the Garden side.

Conditions of Entry—Be sure that each separate exhibit, unless it be a part of the class or school exhibit, has an entry card with the exhibitor's name, school, and address upon it. These entry cards may be had from us in early September, and should be filled in exactly as indicated. Bring the exhibits to the Botanic Garden on September 29 between 8 a. m. and 12 m.

Time of Judging—Three expert judges will judge these exhibits and make public their decisions on September 29 at 2 p. m.

Prizes—This year we are offering for second prizes in *Classes A*, *B* and *C*, books from the Nature Library (Doubleday, Page & Co.), those large and valuable nature books which mean so much to schools. The school winning a second prize may choose those books from the Nature Library which it most desires. In this way, year after year, whole sets may be built up in the schools. We are still offering trophies as first prizes.

We have changed *Class B* from a Community Garden Display to a Small-School Display. We have so many schools which cannot compete in *Class A*. In the Small-School Display, not fewer than ten nor more than fifteen exhibits need be entered. This gives the small school and the one which has no school garden and those where garden interest is only just awakening, an opportunity to be a part of us. Some people have said that our Borough of Brooklyn Exhibit is the best exhibit of its kind by made children in the United States. Let us make the ninth one a record exhibit.

Removal of Exhibits—Exhibits may be taken away by the exhibitors at 4 p. m. on September 30, or at any time before October 4.

Presentation of Prizes—Prizes, both individual and group, will be presented on October 14, at 2:30 p. m., in the auditorium of the Brooklyn Botanic Garden building. No prize winner will receive his prize unless he is present, or sends a substitute, on October 14.

Class A—**School Display.** FIRST PRIZE, a trophy to the school making the best display, to be held for a year only, or until won three times, when it becomes the permanent property of the winning school. Last year P. S. 89 won the trophy for the third time, so it belongs to P. S. 89. SECOND PRIZE, Two books from The Nature Library.

Class B—**Small-School Display.** The conditions for this display are as follows: entries of from ten to fifteen exhibits; potted plants, vegetables and flowers. FIRST PRIZE, Three books from The Nature Library. SECOND PRIZE, Two books from The Nature Library.

Class C—**Box Display.** This display will consist of six sample window boxes from each school entering *Class C*. There are schools where it is impossible to have a school garden, and where the neighborhood is such that it is impossible to have home gardens; for such, this class is added. The FIRST PRIZE in this exhibit is a beautiful loving cup, which shall be competed for under the same conditions as those for the trophy in *Class A*. SECOND PRIZE, a silver cup.

Class D—**Flowers.** This is a class for individual competition, and in which first and second prizes are offered. In this and the following classes the FIRST PRIZES are gold medals; SECOND PRIZES, bronze medals. Certificates of honorable mention will be given as THIRD PRIZES. If a boy or girl enters an individual class, he must understand that these same products cannot count toward his school display. Double entries should be made in such cases. Do not forget this. If you enter zinnias for an individual prize and wish to add zinnias to the school display, then you must bring two bunches of zinnias. The divisions in *Class D* are as follows:—

No. 1. Ageratum
Best 4 sprays

No. 2. Alyssum
Best plant (potted)

No. 3. Asters, blue
Best collection of 10

No. 4. Asters, pink
Best collection of 10

No. 5. Asters, white
Best collection of 10

No. 6. Asters, mixed
Best collection of 12

No. 7. Asters
Best plant (potted)

No. 8. Calendula
Best collection of 8

No. 9. Cornflower
Best collection of 12

No. 10. Dianthus
Best collection of 10

No. 11. Marigold
(Giant African)
Best collection of 12

No. 12. Marigold
(Dwarf French)
Best collection of 12

No. 13. Marigold
Best Plant (potted)

No. 14. Nasturtium
Best collection of 12

No. 15. Phlox
Best collection of 8

No. 16. Sunflower
Largest flower

No. 17. Verbena
Best collection of 10

No. 18. Zinnia
Best collection of 10

Class E—**Vegetables.** Surely this ought to be a popular class this year. Plan ahead so your vegetables will be in their prime at exhibit time. Try to send in perfect specimens. If, for example, you are exhibiting under No. 17, red tomatoes, have your eight tomatoes as nearly the same size as possible. Wash your vegetables carefully, so that they make an attractive appearance. FIRST PRIZES in this class are gold medals; SECOND PRIZES, bronze medals; THIRD PRIZES, certificates of honorable mention.

DIVISIONS IN CLASS E

No. 1. Beans, bush
Best pint, shelled

No. 2. Beans
Best quart, unshelled

No. 3. Beets
Best bunch of 6

No. 4. Carrots
Best bunch of 5

No. 5. Cabbage
Best head

No. 6. Corn
Best 6 ears

No. 7. Egg-plant
Best 2

No. 8. Kohlrabi
Best 4

No. 9. Lettuce
Best 2 heads
(roots and all)

No. 10. Onions
Best 4

No. 11. Peppers
Best 4

No. 12. Potatoes
Best 6

No. 13. Pumpkin
Best specimen

No. 14. Radishes
Best 8

No. 15. Squash
Best specimen

No. 16. Tomatoes, green
Best 8

No. 17. Tomatoes, red
Best 8

No. 18. Tomatoes
Small-fruited varieties
Best 10

Class F—**Best Special Plant.** Any plant cared for by the exhibitor may be entered. The plant may be a geranium raised from a cutting, an aster from a seed, a fern from a runner—it matters not so long as the work is yours. The plant stands no chance of prize winning if it is not in good condition, clean, properly potted, and free from insect pests. FIRST PRIZE, a gold medal; SECOND PRIZE, a bronze medal; THIRD PRIZE, a certificate of honorable mention.

Class G—**Best Bunch of Flowers.** Judged on perfection of the flowers and taste in arrangement. FIRST PRIZE in this class is a gold medal; SECOND PRIZE, a bronze medal; THIRD PRIZE, a certificate of honorable mention.

Class H—**Individual Garden Display.** The greatest variety of flowers or vegetables raised by one child constitutes this display. Here is an opportunity to show some originality and taste in the way you put together and arrange your own exhibit. Let us have more exhibits in this class this year. FIRST PRIZE, a gold medal; SECOND PRIZE, a bronze medal; THIRD PRIZE, a certificate of honorable mention.

Class I—**Weed Display.** This weed exhibit may be one of either fresh or pressed specimens. No exhibit can take a prize unless the specimens are carefully and correctly named. If you go away to the country in the summer you will have a good opportunity to make a large collection of weeds and wild flowers for the exhibit. FIRST PRIZE, a gold medal; SECOND PRIZE, a bronze medal; and certificates of honorable mention will be awarded to those taking third places.

Class J—**Wild Flowers.** Similar to *Class I.* FIRST PRIZE, a gold medal; SECOND PRIZE, a bronze medal; THIRD PRIZE, certificates of honorable mention.

Note.—No individual may carry off more than one first and one second prize in *Classes D* to *J* inclusive.

Class K (*a*)—**Back Yard Gardens.** Boys: Two fine nature books will be presented to the boy having the best back yard garden in Brooklyn. One nature book will be given to the boy having the second best back yard garden. Conditions for these prizes are as follows: First, the garden must be kept by the applicant; second, the garden must be at least 10 x 20; third, plans, diagram, costs of seed, amount of crop must be all submitted in writing to the Botanic Garden at the time of the exhibit. These gardens must be entered in this contest by July 1st, and will be visited at least twice during the season by a judge from the Botanic Garden.

Class K (*b*) - Same for girls as *Class K* (*a*).

ELLEN EDDY SHAW,
Curator of Elementary Instruction.

Note.—Competitors under *Classes A*, *B* and *C* should ascertain their allotted exhibit space by September 15, from the Curator of Elementary Instruction.

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BROOKLYN BOTANIC GARDEN

LEAFLETS

SERIES X BROOKLYN, N. Y., MAY 3, 1922. NO. 3

EVOLUTION AS ILLUSTRATED BY FERNS

More than sixty years ago, Charles Darwin wrote into the minds of men at large the idea that similarities between existing species of plants and animals indicate relationships, further convincing evidence of which may be found in geological series which constitute the genealogical records. Expressed in other words, he firmly established the idea that creation has been, and still is, a process of continuous evolution. At first, many refused the new thought as contrary to old, accepted beliefs and teachings. Today, on the contrary, it is a matter for wonderment when someone, supposedly intelligent, rises to attack the accepted faith in the law of evolution; and we place together, intellectually, the anti-evolutionist and that other, who declared (according to a recent news item) that the earth is flat and that the sun revolves about the earth.

It should be emphasized here that while Darwin is responsible for the general acceptance today of evolution, the idea did not originate in his mind, but had been thought of from time to time since the days of Aristotle. Darwin's contribution was a description of a workable method, that of natural selection, by which species may have been differentiated. As evidence of this method, Darwin presented an overwhelming mass of facts, the result of nearly thirty years of world-wide travel and intensive study.

Today, evolution is a commonplace in the minds of those who view the facts with open minds, and is as well established as the fundamental laws of chemistry and physics; as well or better founded than molecules and gravity, and rests on the same basis of reasoning; namely, the inferring of causes from activities and results.

Ferns supply ample evidence of evolution along the lines on which Darwin originally worked; of similar and related species, and of continuous geological lines of progress, extending far back into the coal period, much earlier than the line of any other of the larger land plants. It is a matter of great significance that to those fern relatives of primordial forests we may trace the ancestry of practically all the common and important plants of today. It is a matter of more than passing interest also that to these same primitive plants we owe in large part our coal and mineral oil supplies of modern industry.

Within the last twenty-five years there has grown up among scientists a desire to add to the comparative and geological evidence of evolution that of experimental proof. If plants and animals of today have really arisen from those of yesterday, as the geological record indicates, it should be possible somewhere and somehow to detect a species in the act of origin. It should even be possible to examine the specific causes which may lead to the appearance of new forms, and perhaps to control or guide these causes so that new species might be produced at will. With these aims in view, the last two decades have seen increasing attention paid to the study of experimental evolution, and in the course of this time, much controversy has arisen regarding the minutiae of the evolutionary process. In some of these disagreements the anti-evolutionist has thought to find the basis for refuting the whole theory, misunderstanding the relative insignificance of the disputes as to method.

What have been the results of this experimental study? Have new species been seen in birth? Have they been experimentally produced? The answer hinges upon the definition of the term "species." It will be worth while to consider in an elementary way just what is meant by a species. Probably no two scientists agree exactly upon the definition of the word species, but it will not be necessary here to go into the details of the difficulty. It is, perhaps, sufficient to say that a species includes all such individuals which, in plants, resemble each other so closely that they might have been raised from the seeds of one parent plant.

What experimental evidence can ferns offer relating to the appearance of new species? We may answer this best by consideration of the history of the common house plant known as the Boston fern. Up to about 1895 one of the common ferns of the commercial greenhouse was the so-called sword fern (*Nephrolepis exaltata*), common in Florida and in the tropics, and reasonably uniform in its characteristics wherever found. It had been cultivated by florists for about a half a century and had come to be rather common about twenty-five years ago. About that time a florist near Cambridge, Massachusetts, found among his sword ferns a new sort, in many respects like the sword fern, but differing in several particulars which made it a better house plant. For example, its leaves were softer and more graceful, and it produced more leaves in a pot of a given size, making a more compact, bushy plant. Becker, the florist concerned, thought he had a species entirely different from *exaltata* and sold it at first under the name of another known form. Later, the error was corrected, and the Boston fern, as it came to be known, was distributed very widely among florists, and grown in increasing numbers until the annual production reached many hundreds of thousands of plants.

As thus grown throughout the country, the Boston fern remained the same, and plants from the southern states, and from the western, northern or central part of the country, could not be distinguished from those of eastern Massachusetts. Six excep-

tions to the above statement must be noted. Within a few years of each other, there appeared in the greenhouses of commercial growers in five states, amid countless thousands of normal Boston fern plants, six new varieties, sports, or mutations; in other words, different kinds of ferns. It is of interest that these six new ferns may be grouped in three pairs, representing three kinds of differences, as compared with the Boston fern.

Here in Brooklyn, in the greenhouse of John Scott, there appeared one form which differed from the Boston fern in being smaller, about two thirds as long, and with the leaf divisions (pinnae), somewhat curved and rolled. In New Jersey, in the greenhouses of George Giatras, there appeared another smaller form, not more than half the length of the parent form, and with other differences making it even more distinct. Each grower named his variety after himself, as is the trade custom, and so we have the Scott fern and the Giatras fern. (Plate I, fig. 2).

In Massachusetts, and in Tarrytown, New York, another pair of new varieties was found, which differed from the Boston fern in having the leaves divided twice instead of once; *i.e.*, each lateral division was again divided, making each like a miniature leaf complete in itself. The Tarrytown fern was called Piersoni after its introducer, and the Massachusetts fern similarly was designated the Foster fern. (Plate II, fig. 2). Although alike in the amount of leaf division, they differed considerably in particulars of growth and shape of leaflets.

The third pair of new forms differed less from the Boston fern and from each other than those already mentioned, but were yet entirely distinct and recognizable. In both cases the leaves showed an increase in ruffling, *i.e.*, instead of being nearly flat and plane, the lateral divisions (leaflets or pinnae) were much fuller and somewhat crinkled, making a more beautiful leaf. Between these two new varieties, called respectively the Harris fern after its discoverer, a Philadelphia florist, and the Roosevelt fern, produced in Ohio, the main difference was a matter of size.

On these six forms the case of evolution might well be rested. They are not strictly "species," although perhaps four of them offer sufficient differences to justify separation. In common with the parent Boston fern, these new forms are able to reproduce only by runners. Whether or not, if they had originated in nature, they would succeed as species under wild conditions, it is at present difficult to judge. It would be most interesting if an experiment on a large scale in some Florida woods were feasible; if, for example, colonies of several scores of plants of each of the different new forms could be set out under wild conditions and left for a year or more. It may be added, incidentally, that although there is possible doubt as to the survival value of these original Boston fern varieties, there is in the collection at the Brooklyn Botanic Garden, another series of new forms, which have had their origin there, and about whose fitness to survive there can be no possible doubt.

These six Boston fern varieties just referred to illustrate two

of the aspects of evolution even if their claims to consideration as actually demonstrating evolution may be doubted. Evolution contravenes heredity. According to the laws of heredity, the original sword fern should have produced only sword ferns, but the Boston fern appeared as something different. Again, accord-

PLATE I

LEAVES ILLUSTRATING DWARFING, AND SPORTS OF GIATRASI *

1. Var. 'bostoniensis.' 2. 'Giatrasi.' 3. Dwarf sport of 'Giatrasi.'
4. Two-pinnate sport of 'Giatrasi.'

ing to heredity all Boston ferns should forevermore have produced only Boston ferns, but there are at least the six exceptions described above. The second point to be noted is the fact that evolution is none the less only the rare exception to the law of heredity. Probably more than twenty million Boston ferns have been grown and sold within the last twenty odd years, but in that time only six certain exceptions to heredity have come to life.

* From Bull. Torrey Club **43**: pl. 15. 1916.

Heredity conserves the old or existing types. Evolution produces something new, different from the old, but how or why, no one can really say with certainty. What determines whether a new form so produced shall continue to exist? Under conditions of civilization, survival value depends on utility, practical or

PLATE II

LEAVES OF BOSTON FERN VARIETIES ILLUSTRATING A DIVISION SERIES*

1. Var. 'bostoniensis.' 2. 'Pierson.' 3. 'Whitmani.'
4. 'Magnifica.' 5. 'Craigi.'

decorative, to man. Man selects from among wild ferns those forms most desirable in his eyes, and most easy to grow. From among their variations, he has selected those new forms which further possess the same qualities. Nature, on the other hand, demands not necessarily beauty in form, but, among other qualities, particularly vigor of growth, and ability to survive adverse conditions. It will be a matter of exceptional scientific

* From Bull. Torrey Club, **43**: pl. 10. 1916.

interest to apply to these Boston fern sports, and others, not pertinent to this account, the test of actual conditions, to determine whether they are fit to survive on a natural selective basis as well as on that of artificial selection.

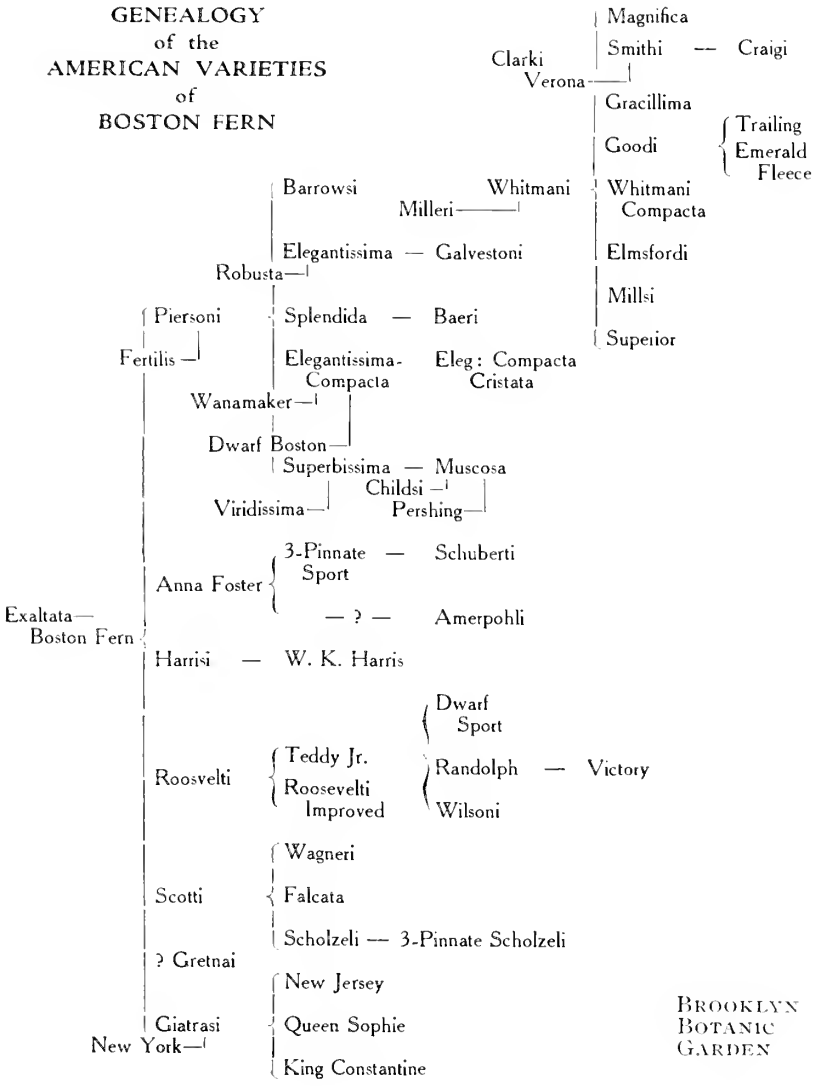
An interesting and illuminating differentiation between the natural and artificial selective methods may be postulated in the case of the development of the races of domesticated and wild canine forms. Some savage—more than once it must have happened—finding a den of wolves, made captives of the young as playthings. Sometime, among such a captured litter, there must have occurred at least one puppy more susceptible of taming, which liked captivity, and came to depend on its human captor for protection. Many wolf puppies have been captured, and more or less tamed, but generally less, because it is a hereditary characteristic that the average wild animals shall distrust confinement, and resist taming. The rare variation, the tameable wolf puppy, would delight the man captor, and in time it might add its value as protector of the household, warning off its former associates. But what would be the fate of such a milder, less ferocious puppy under wild conditions? To ask is to answer. Nature does not seem to have selected wolves on the basis of mildness, and tameableness.

To apply the conclusion of the foregoing: from the Boston fern there have developed variations which answer the test of specific differences as far as distinctiveness is concerned. Whether they would all survive under natural conditions remains to be tested. Some variations, however, have been found, and have occurred at the Brooklyn Botanic Garden, which answer the difference test, and would undoubtedly survive under the conditions of natural selection.

But the Boston fern has gone much further along the lines of demonstrating evolution than merely producing six distinctive new forms. Each of these has continued the process. While remaining constant in their own characteristics, following the law of heredity in the great mass of progeny, each of the six cited above has given rise to new forms, well distinguished from their parents, and like them able to breed true, *i.e.*, they are variations of the kind called mutations. Two illustrations will suffice. From the Pierson fern, itself twice divided, has come the Barrows fern, somewhat smaller and more consistently twice divided. From the Barrows fern has come the Whitman fern, three times divided. (See Plate II). From the Whitman fern has come the Smith fern, four times divided, and lacy; and from this, an apparent end to this line of progression, the five times pinnate Craig fern. Similarly, from the Giatras fern has come another type accentuating the reduced size, a dwarf variety less than one sixth the size of the original Boston fern, named, as it happened, the New Jersey fern. (See Plate I.) From the original ruffled forms, have come new forms with a greater degree of ruffling; from divided varieties there have appeared dwarf divided forms. It appears that these types of variation may be shuffled and

redealt in almost endless permutations and combinations. The end result is that within scarcely more than twenty years, florists have detected and named probably seventy-five distinct variations, from some one of the forms first separating from the Boston fern; and the total number of forms which have appeared, many not named, undoubtedly exceeds two hundred.

In the same house with the exhibit of Boston fern varieties at the Brooklyn Botanic Garden a chart has been set up at the entrance which shows in a graphic way the genealogical tree of the different varieties as follows:



BROOKLYN
BOTANIC
GARDEN

In diversity of form, size, growth characteristics—in other words—in criteria which are used to separate species of the wilds, these new forms have exceeded the limits of variations among the wild species of *Nephrolepis*, the leaves of all of which are only once divided, and often hard to differentiate. Recently there have come to my attention forms of the Boston fern series in which the leaves reproduce new plants, besides forms with corkscrew twists in the leaves, and also forms showing other types of variation extraordinary for this genus.

The multiplicity of different types of variation is interesting, but even more so is the fact that along the main lines of variation, leaf division, dwarfing, and ruffling of leaves, there have appeared such consecutive series, in which each of these characters has been intensified. Such series of variation are called *orthogenetic*, and there is a growing belief among students of evolution that orthogenesis, so called, or in other words, evolution in a definite direction, must be accepted to account for many of the phenomena of variation evident, both in fossil forms and in present day groups of species. (See Chart, page 7.)

Both as regards orthogenesis, and as regards the presentment of definite new forms, recently evolved, the Boston fern offers evidence without precedent among other groups of plants and animals. The ultimate status of these new ferns as "species" must be left open for further study.

R. C. Benedict.

An exhibition of about seventy-five varieties of the Boston fern has recently been installed in House No. 10 of the conservatories of the Brooklyn Botanic Garden. This is practically the same collection as the one displayed by the Garden last fall at the exhibition of the Massachusetts Horticultural Society in Boston, where the officers of the Horticultural Society created a special prize and awarded a gold medal to the Brooklyn Botanic Garden on account of the unusual excellence of the collection.—Ed.

The Leaflets are published weekly or biweekly from April to June, and October to November, inclusive, by the Brooklyn Botanic Garden, Brooklyn, N. Y.

Telephone: 6173 Prospect. Mail address: Brooklyn Botanic Garden, Brooklyn, N. Y.

BROOKLYN BOTANIC GARDEN

LEAFLETS

SERIES X BROOKLYN, N.Y., MAY 17, 1922. NO. 4

BRAZIL NUTS

Bertholletia excelsa is the name the scientists have attached to this rough-barked forest giant of the Amazon river basin, but to most people who eat its buttery nuts, it has other labels. In Bolivia, they fancy its three-sided oily seeds resemble in some way the almonds of their ancestral Spain, so they call them "almindras," the Spanish for almond. In Brazil, these nuts reminded the dark skinned Portuguese colonists of the chestnuts that clothed the mountain slopes of their distant motherland, so to them they are "castahnas," the Portuguese for chestnut. And we English-speaking folk know them as Brazil nuts, Para nuts, butter nuts and "nigger-toes."

"Almindras, senor," the Indian boatman said, as he pointed to a coffee-drying frame, covered with the drying nuts. And a short distance away towered the giant tree which gave them birth, some of the Earth-shaped fruit cases, 4-6 inches in diameter, still attached to the parent limbs like brown balls on a giant candelabra. Beneath the tree were many empty cases, from which the natives had taken the 12 to 24 nuts which each case contains. And as I left the boat to view this forest monster, the fruit of which had long held treasured boyhood associations for me, I confess to feeling like our friends who want to shake hands with the President or with some other prominent member of the human species. I almost wished this giant tree were human so I could have spoken with it and told the friends back home, as we sat about the fireplace on a cold winter night, eating the nuts—how "when I was in Bolivia, you know, I met Senor Bertholletia and shook hands with him. Awfully democratic fellow—not a bit snobbish."

As I stood one day admiring the hundred feet, more or less, of rough bark-clothed trunk and the long, handsome, glossy, dark-green chestnut-like leaves, one of the big balls fell from the sixty-foot perch above me, hitting the undergrowth and ground with a crash like the nearby report of a gun. And as Mr. Longfellow said of the famous Finney turnip,

> "There it lay and it lay
> Till it began to rot."

That is, the fruit cases have no natural method of opening and dispersing the nuts, so that they can sprout and produce more trees, except through the rotting away of the fruit case walls.

For the nuts are well protected by a hard case with two coverings or skins, after the manner of the hard and soft husks of a black walnut. The outer is bark-like, brown and stippled with gray specks, while the inner is hard, woody, very ridged and rough and from one-fourth to one-half an inch thick. Through both these coverings, at the opposite end to where the fruit was attached to its parent, there is a small opening, perhaps a half inch across, made by the falling inwards of a structure somewhat comparable to a "stopper" that fits a bottle with a neck larger at the base than at the top. Through this small opening, a varied assortment of cockroaches and other insects enter and clean up the debris resulting from structures once necessary to the growth of the nuts. And sometimes when one picks up one of these fruits, out come a horde of cockroaches of various sizes—I counted twenty in one instance—which rush off among the dead leaves as though they were commuters making their morning train.

But the native Brazil nut collector does not wait for nature's method of delivering the nuts. As soon as the fruits have largely fallen—January to March or even earlier in some localities—he collects them in convenient-sized piles, takes his machete, hacks off the top third, empties the nuts into a sack or basket, takes them to the river and washes them, dries them for several days, and stores them in pile-supported, palm-thatched huts from whence they are loaded into a river steamer.

During the Brazil nut harvest, these steamers go poking their prows into all sorts of weird places—little flooded forest alleyways, inlets, small palm-thatched villages that geographers have never heard of, or else have long since forgotten—the dark-skinned buyers calling from the steamer railing as a house or village is approached, "Hay, castahnas!" and on a favorable reply, the big boat, perhaps already loaded almost to capacity with balls of rubber, baskets of farina, and tons and tons of nuts loose in the hold, in baskets, or in bags—whistles and swings in. A plank is pushed ashore and the half-naked, barefoot natives begin, each with a basket on his head, to carry on a few more tons. Palm-thatched *montaria* boats, loaded level to the gunwale, appear here and there coming through the dark forest wall as if by magic, and add their quota. And this performance continues day after day, as one drops down the rivers tributary to the Amazon, through the low-lying, forest-flooded Brazil nut country, until finally one reaches Manaos—one thousand miles up the Amazon—the metropolis of the Brazil nut trade.

Here one meets the ocean steamers, and they too are loading Brazil nuts. Great steel barges with sliding iron whaleback covers are shoved alongside by puffing tugs, and all through the day and often through the night, too, the steam winches clank their chains, as they lower and raise their steel buckets to and from the barges, filling the hold with nuts.

Once full, the ocean freighter puts on full steam and with open hatches, except in stormy weather, hurries northward, for Brazil nuts are a perishable cargo. Often loaded wet, they must

be constantly shoveled ("trimmed" is the technical term), back and forth and up into ridges, to keep them from sweating, heating, and spoiling. So, all day long, during the ocean voyage to Liverpool or New York, you hear the shovels plying in the nut bins far down in the hot and dusty holds. Sometimes it becomes necessary for even the officers to take a shoveling spell.

In this way, the 16,800 tons of Brazil nuts that I was told constituted this year's crop were gathered and shipped. And where do they go, you well may ask, for 16,800 tons are a lot of nuts. Who eats them? Not many of them are used in their home country, but most of them go to the United States or to England. From England they are shipped to various European countries, but in most years, the Americans eat about twice the tonnage that goes to Europe. This year, the bulk of them are said to have gone to England. On the river boat Tupy, in which we came down the Madeira River to Manaos, were over 116 tons of Brazil nuts, and our ocean steamer from Manaos to New York carried about 1500 tons.

And now that the "black gold" industry of South America, otherwise known as "rubber collecting," has been overshadowed by the development of rubber plantations in the Orient, the Brazil nut harvest is one of the main interests of this part of the world. One hears Brazil nuts discussed from every possible angle among the passenger groups on the steamers that nose their way up and down the forest clad Amazon basin. On the docks at Manaos, it is the same story—in the banks and steamship offices also—"How is the harvest?" "What is the price?" Castahnas in this part of Brazil hold the same importance as a topic of conversation as corn in Illinois, cattle in eastern Montana, or wheat in North Dakota. Outside the great valley drained by the streams of water that we know as the Amazon river system—that mighty yellow flood that courses through the densest forests on the globe—the Brazil nut is unknown. And yet even here the trees are rarely planted. Slow-growing, hard-wooded, a lover of the hot, moist, low lands,—lands subject to such annual overflows that miles and miles of flooded forest appear during the period of the great rains—there it is that the brazil nut tree rears its giant dome of foliage, flowers, brings forth its great fruit and lives its life span. Through the forest tangles, here and there, you see its rough-barked bole, so strange amid the hundreds of smooth barked trees. And to this tree the Indians, to whom of old these woods were home, came, and from its tough, soft, inner bark, pounded out a suit of clothes—a one piece suit of cloth which reminded one of the tapa cloth made from the paper mulberry by the South Sea Islanders. To some extent they still make use of it, but mostly they wear the cloth of white man's cotton. And now the bark is used for caulking boats—*estope*, they call it.

One must not get the idea that Brazil nuts grow in pure forests of their kind, as often do the pines, spruces and hardwoods of our own land. A tropical forest is more heterogeneous in its makeup than a large Woolworth store, or of more varied composi-

tion than the people of a downtown New York street at lunch hour. And in certain regions, all the varied races of plants that make up a tropical forest society—figs, palms, soap trees, garlic trees, cow trees, innumerable members of the pea family (such as the tan bark *vilca* and the purple heart), climbing milkweeds, perching cacti, climbing ferns, orchids, Bromeliads (the pineapple family); thin, twisted, flat, round, big and little vines and climbers; arums, rubber trees and hosts of others—present the appearance of climbing over and clambering on top of each other—anyway to get up—up toward the light and sun. Here the struggle for life in the plant world—for a place in the sunlight, is perhaps the most strenuous of any area in the world, corresponding perhaps to the struggle among human beings in such densely populated areas as India, China and our own city of New York. In all directions, as one traverses this great forest region, are strewn the dead and dying—unnoticed mostly, except by the naturalist, because there are so many to take their places, even before their struggle is over. And so one finds almost innumerable species, but only a few plants of this, a few bushes of that, and few trees of one kind near together. Here in this Brazil nut country, the red howling monkey sings his morning and evening song; the tapir browses with its young beside the canebrake-walled streams, and on the sandbars the giant turtles lay their eggs by millions. Here, too, the cacao or chocolate tree matures its pumpkin-colored fruits, and vanilla pods scent the forest with their fragrance.

ORLAND E. WHITE.

NOTABLE GARDEN FEATURES OF THE SEASON

The 12,000 daffodils, naturalized in the lawn just west of the Laboratory Building, have passed their prime, but beyond and above them, thousands of rosy Darwin tulips, also naturalized, are bursting into flower, in a lovely silent harmony of pink and green. Now is the appointed time for Azaleas and Rhododendrons. Some of these have been in bloom for several days—most striking of which is the Japanese Hinodigiri variety, of a brilliant crimson color. The Azaleas have clothed the knolls at the southwest part of the Garden with masses of gorgeous colors. In the Lilac plantation in the northwest part of the Garden, over 120 varieties, many of them rare hybrids of French origin, delight the visitor with their delicious fragrance, some of them with marvelous shades of purple, and others of the purest white. Perhaps the most beautiful feature of the Garden at present is the Japanese Garden, which for picturesqueness and exquisite color baffles description. A. H. G.

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BROOKLYN BOTANIC GARDEN

LEAFLETS

SERIES X | BROOKLYN, N. Y., MAY 31, 1922. | NO. 5

THE WARDIAN CASE: A DEVICE FOR GROWING PLANTS IN THE SCHOOLROOM OR LIVINGROOM

A love of plants seems to be almost universal, for most of us like to have them about us in the house as well as out-of-doors, yet many people find it well-nigh impossible to keep plants indoors in a healthy condition. Particularly is this true of plants in the schoolroom, where they often lack care for a portion of each week, and, unless special provision is made, are apt to suffer during the long vacations.

There are many reasons why these indoor plants often become sickly, droop and die, even though they receive constant care; but the chief causes are poor light, dryness of the air, and the presence of dust and gases. The need of light is, of course, essential: as to dryness of the air, this is probably more responsible for the failure of indoor plants than any other cause. The cold air taken in from out-of-doors in the case of furnace-heated houses has a temperature varying from perhaps zero to 40°. It becomes heated to 70° or over, and although the heating vastly increases its moisture-holding capacity, as a matter of fact it contains no more moisture than when it was a cold air. Therefore, it *feels* like a dry air, for its relative humidity is very low. "In Death Valley, California, one of the driest places on earth, the average relative humidity for five months, when the record was kept, was 23; yet this is but *little less than the relative humidity of the air in the average furnace-heated house in winter.*"* No wonder that we take cold after such air parches the membranes in our lungs, and we go forth at any moment into the sharp, chilling air out-of-doors. No wonder that plants also suffer in such a desert environment! And so, for want of knowledge as to how to obviate these difficulties, the attempt to grow flowers or green things in the home or school is often regretfully abandoned.

About ninety years ago, Nathaniel Ward, a London physician, stumbled upon a method of raising and keeping plants in an environment otherwise quite unsuited to them. As a child he had admired the old brick walls, often seen in English gardens, covered with mosses, ferns, and primroses; and had built one in

* Salisbury, R. D., Barrows, H. H., and Tower, W. S. The elements of geography. N. Y., 1912. p. 90.

London. He tended it carefully, but the London atmosphere was most unfavorable, and one by one his plants died. One day he discovered a sphinx-moth cocoon, and, wishing to see it hatch, put it in a glass bottle containing some rich, damp loam and covered with a piece of tin. To his surprise, in a few weeks a young fern and a small grass plant appeared and continued to grow in the bottle, although similar plants had promptly died on his brick wall. Wondering why these bottle plants thrived, he concluded that it was for the following reasons: the air was free from soot; there was plenty of light; the glass kept the temperature even; the moisture was constant; and the air was quiet, yet the lid allowed some ventilation. "Thus, then," he says, "all the conditions necessary for the growth of my little plant were apparently fulfilled; and it remained only to put it to the test of an experiment. I placed the bottle outside of my study —a room facing the north—and to my great delight the plants continued to grow well . . . They required no attention, the same circulation of water continuing; and here they remained for nearly nearly four years . . . At the end of this time they accidentally perished, during my absence from home, in consequence of the rusting of the lid, and the admission of rain water."*

Finding that his "bottle" fern grew so well, Dr. Ward experimented with many plants in cases of different sizes and became more and more enthusiastic over the possibilities of growing plants "in closely glazed cases." Speaking of a fern, lovely, but exceedingly "intractable under ordinary methods of cultivation," he tells how "Baron Fischer, the superintendent of the botanical establishments of the Emperor of Russia, when he saw the plant growing in one of my cases, took off his hat, made a bow to it, and said: 'You have been my master all the days of my life.'"

In one glass-enclosed case about 10 feet square, containing small palms and ferns, he kept an English robin for several months, and in another, on the top of his house, he grew alpine plants, which however, finally died from too much sunshine in the summer. He describes how he kept ferns and mosses alive "which had been planted nine years before in the bottle, after the first experimental plants had sprung up and perished. "The soil is a mixture of peat mold, loam, and sand, with as much moisture as it would retain when water was poured through it. The same water has served for the nourishment of the plants up to the present time, nor am I able to assign any limit to their existence in this state."

Dr. Ward's cases found a very practical use in transporting seeds and plants to and from foreign countries. In those days of slow sailing vessels, it was with great difficulty that living specimens were sent from one country to another, particularly when this involved crossing the equator from one hemisphere to another. Rare and delicate plants, often procured at great hazard, were apt to die on the voyage from cold, lack of water, or from the

* Ward, N. B. On the growth of plants in closely glazed cases, pp. 26, 27. London. 1842. 95 pp.

suffocating gases of the hold. In 1833, two cases were filled with ferns, grasses, etc., and sent from England to Sidney, Australia, in perfect condition. There they were refilled with other plants and sent back. The voyage required eight months, the plants being on deck and not once watered, yet they arrived in the most healthy and vigorous condition. The cases permitted the plants to grow in plenty of light and the lack of air currents about them minimized the dangers from sudden changes of temperature.

WARDIAN CASE IN USE AT THE BROOKLYN BOTANIC GARDEN

Plants (left to right): **Codiaeum evansianum** (broad leaf with veins at right angles to midrib); **Sansevieria thyrsiflora** (narrow leaf with dark bands); English Ivy (heart-shaped leaf); **Peperomia maculosa** (in front, middle); variety of Boston Fern, (in rear); **Dracaena deremensis** (long leaves); **Codiaeum aucubaefolium,** (right hand corner, in front).

Dr. Ward felt that his cases would do much to brighten the lives of the poor, enabling them to beautify their homes and to raise flowers and vegetables they might not otherwise have. His expectations have hardly been realized, yet the Wardian Case, as it is called, should be better known. It can be constructed at a moderate cost, requires little care, and in it a variety of plants may be grown, so that it adds greatly to the attractiveness of the home or school.

Construction of the Wardian Case

Cases of a great variety of shapes and sizes may be made: Dr. Ward experimented with many different kinds. The small window garden commonly made with earth and plants in a goldfish globe covered with a pane of glass, is a Wardian case in principle—a fairly tight chamber with sides and roof of glass, and containing air of high relative humidity—in fact, a miniature greenhouse.

A Wardian case similar to that in use at the Brooklyn Botanic Garden may be made as follows: the framework for holding the glass consists of four upright pieces 1 x 1 x 16½ inches, with grooves a quarter of an inch deep on two sides for receiving the glass of the sides and ends of the case. The floor is made of matched boards about one inch thick, and is perforated with about a dozen holes one inch in diameter, at fairly regular distances apart, for ventilation. Before the soil, which consists of equal parts of sand, leaf mold and loam, is put in, these holes are covered with crock after the method used in potting plants. Underneath the floor, at convenient distances apart, two cross pieces about one and three-quarter inches wide and an inch thick, may be fastened, on which the whole case rests; so that air freely circulates under the body and has access to the holes in the bottom.

The body of the box, which is fastened directly to the uprights by lap joints, is 14½ x 21¾ x 6 x ½ inches, outside measure. The upper, inner edges of the body boards are rabbeted one-eighth by one-eighth inches to receive the glass. These rabbets must be in exact line with the grooves in the uprights when assembled. This makes it possible to use for the two sides two panes of glass 10 x 20 inches, and for the ends two pieces 13 x 13 inches, cut at the top end to form the gables. The panes used for the roof are 20 x 8½ inches. Four removable wooden pins serve as keys to prevent the glass roof from sliding from place.

It is not necessary to have a peaked roof as in the figure (p. 3). A "lean-to" glass roof may be used, or even a flat roof, but in the latter case, books or other objects are apt to be laid on top, shutting off the light and perhaps breaking the glass. The form with peaked roof shown in the illustration has a neat appearance, and, moreover, by the use of the wooden pegs which fit into holes at the lower ends of the four slanting pieces, the top glass panes may either be held tight to the "ridge pole," or lowered an inch or so for ventilation.

Plants for the Wardian Case

In the selection of suitable species for the Wardian case, the chief points to bear in mind are that they do not become too large or grow too rapidly. Also, some plants do not thrive in such a moist environment, as, for example, the Geranium, which soon becomes affected with mold. In general, the plants must be tough-leaved and not prone to mildew.

Besides the collection of species shown in the figure, many of which cannot be obtained from the florist, the following kinds may be suggested, all of which are readily obtainable:

1. English Ivy
2. *Anthericum variegatum*
3. *Tradescantia* sp.
4. *Cyperus alternifolius*
5. *Begonia* sp.
6. Small palms
7. *Pteris* ferns
8. Boston ferns
9. *Selaginella* sp.
10. *Croton* varieties

If mold appears on the surface of the soil, or if the leaves begin to rot, it is evident that too much moisture is present, and ventilation is needed. The plants shown in the illustration above were last watered March 2, 1922, and have had no attention of any kind since. At present (May 24) they are in an extremely vigorous condition.

Cases that are to be left in the schoolroom during long summer vacations may be placed in a north window and left without any care. If they are at a south window, they should be moved back a little so that they will not have too much sunlight, or else they should be partially shaded.

ELSIE HAMMOND.

NOTABLE GARDEN FEATURES OF THE SEASON

The most beautiful features of the Garden at present are the Irises and Rhododendrons. Both of these may be seen in the Japanese Garden, although the Irises are scattered along the brook to the southward as far as the willows, making splashes of rich yellows, blues, or purples along the stream banks. Most of those along the brook were received by the Botanic Garden as gifts from various growers and breeders. The most gorgeous effect of all is made by the collection of Irises near the banks of the lake in the northeast part of the Japanese Garden. Here are flowers with wonderful combinations of purple and yellow; white-flowered sorts with pale stripes on their petals; flowers with a beautiful blending of lavender and cream color; also the well-known bright yellow sorts—all forms of the bearded type (*Iris germanica*). Below these, nearer the lake, a group of Japanese Irises with more slender, erect leaves, and larger flowers (not bearded) are scheduled to bloom later, and will take a prominent part in the floral symphony during the latter part of June, and through July. The Botanic Garden has a cooperative agreement with the American Iris Society with a view to making a collection of the different varieties and studying their merits and nomenclature, for considerable confusion exists as regards the correct names of the different varieties.

At the western end of the lake, near the outlet to the brook, are masses of Rhododendrons, now in their prime—rose, white,

lavender and crimson. This spot is now popular with artists, and during the past week a class from the Pratt Institute received instruction as to how to reproduce on canvas these marvelous colors, as well as the light and shade effects of the tall, dark, evergreens mirrored in the lake.

Elsewhere in the Garden the Viburnums are in evidence; the Weigela, with its rosy, trumpet-shaped flowers, may be seen at the northeast corner of the Japanese Garden about the Irises, and also near the Local Flora close to Flatbush Avenue. The Azaleas, though waning, are still attractive near the southwest gate, and the Robinias or Locusts on the knoll west of the lily pools are displaying their long spikes of white or rose-colored flowers. The Rock Garden, too, continues to be a never-failing source of pleasure. A. H. G.

DOCENTRY

Throughout May and June, and September and October, for the assistance of visitors in studying the collections, a docent will leave the front door of the laboratory building every Monday, Wednesday, and Friday (weather permitting) at 3 p.m., as per the following schedules:

Spring Schedule

Monday	Japanese Garden Wild Flower Garden
Wednesday	Rock Garden Conservatories
Friday	Herbaceous and Shrub Garden Ecological Garden

The service is free to members of the Botanic Garden: for others there is a nominal charge of 10 cents a person.

NOTICES

The Garden is open free to the public daily, from 8 a. m. until dark; on Sundays and holidays at 10 a m. The Laboratory Building, containing the library, herbarium, and offices, is open daily (except Sundays), from 9 a. m. until 5 p. m. (Saturdays, 9–12). The Conservatories are open April 1–October 1, 10 a. m.–4:30 p. m. (Sundays, 2-4:30); October 1–April 1, 10 a. m.–4 p. m. (Sundays, 2-4).

The Garden may be reached by Flatbush Avenue trolley to Malbone Street (Empire Boulevard); Franklin Avenue and Lorimer Street trolleys to Washington Avenue; St. John's Place trolley to Sterling Place; Ninth Avenue, Union Street, Vanderbilt Avenue, and Smith Street trolleys to Prospect Park Plaza and Union Street, and Brighton Express, Broadway (B.R.T.) Subway, to Prospect Park Station, north exit; Interboro Subway, Eastern Parkway-Brooklyn Museum Station, east exit.

Subscription for LEAFLETS **fifty cents a series** (comprising ten or twelve numbers); free to members of the Botanic Garden and to teachers.

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BROOKLYN BOTANIC GARDEN

LEAFLETS

SERIES X BROOKLYN, N.Y., JUNE 14, 1922. No. 6

THE EVOLUTION GROUP AT THE BROOKLYN BOTANIC GARDEN

There is a certain parallelism in the history of the classification of plants and of animals. In both cases obvious characteristics were first used.

For example, whales were long classed with fishes. Later, the facts that they have lungs and warm blood and that they give milk to their young, made it clear that they are not really fishes at all, but nearer to animals like dogs and horses. In short, there is a group, mammals, having these and other characters, but fishes are an entirely different group.

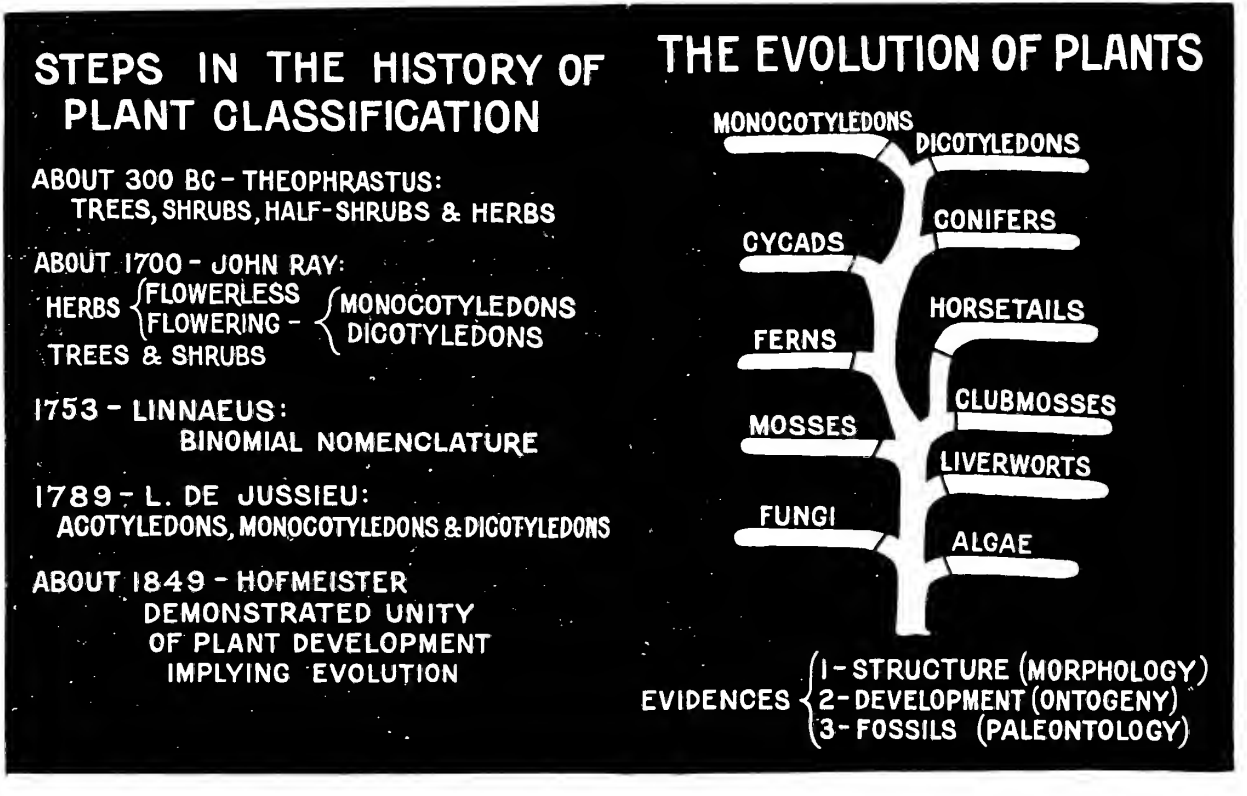
Similarly, locust trees were classed with trees, and peas with herbaceous plants. Later, the close resemblance of the flowers, fruits, and seeds, as well as leaves, of locusts and peas, made it appear that these should be included in a natural group of related species, namely the Pea Family. So that the old classification, namely, trees, shrubs, and herbaceous plants, was not a natural one.

Thus, gradually, the idea of natural affinity developed as the basis for classification. During the nineteenth century it became clear that affinity really meant relationship—that the question of natural classification of plants and animals was really the question of their evolution.

Leading facts relating to plant evolution had been demonstrated by Wilhelm Hofmeister, about ten years before Darwin's "Origin of Species." Hofmeister was for a number of years a music dealer in Leipzic, giving all his spare time to the study of of plants. It was he who first recognized the universality of the phenomenon of alternation of generations in all plant groups from liverworts to seed-bearing plants, inclusive. Hofmeister states facts only, without explanation. But the evidence of the essential unity of development of the varous groups of plants implies the principle of evolution.

It appears that not only the plant world, but the whole of life, is really one great tree, of which the living plants and animals are, so to speak, the growing tips of the branches. No form is separate; as we go back the various forms converge, and all are united through the life of the past.

What is the form of the tree of evolution? There are three



LABEL FOR THE EVOLUTION GROUP AT THE BROOKLYN BOTANIC GARDEN.
THE LIVING PLANTS ARE THE TIPS OF THE BRANCHES OF THE TREE OF EVOLUTION.

main lines of evidence. The most convincing is that gained from fossils, or the remains or imprints of plants or animals of the past. The fossil evidence relating to the horse has been called the "*edition de luxe*" of evolution, because every link is found between the modern horse and its five-toed ancestor.

But in most cases the fossil links are incomplete, and it becomes necessary to complete the tree of evolution by evidences from the comparison of living forms (*morphology*), and by their development (*ontogeny*). Thus, the fact that frogs come from tadpoles suggests their ancestors, the fishes. The thread-like *protonema*, the early stage of mosses, suggests their ancestors, the algae. The *prothallium*, the early stage of a fern, is very much like a liverwort.

In House No. 2 of the conservatories of the Brooklyn Botanic Garden, types of the principal groups of plants have been arranged to indicate their approximate relationships, that is, in the form of a tree. The trunk denotes the main course of plant evolution; on the branches, representatives of the various groups are growing.

The label for this exhibit is reproduced on page 2. On the left are data showing important steps which have led toward a natural classification of plants; and on the right, a diagram, intended to represent approximately present views as to plant evolution. These groups are assigned somewhat varying ranks by different botanists. It is not proposed here to outline a complete plant classification. Important stages of plant evolution may be summarized as follows:

1. Algae, mostly water plants, without archegonia. Fungi are a side line.
2. Liverworts and Mosses, moist-soil plants, with *archegonia*, but no roots.
3. Clubmosses and Horsetails, "dry" land plants, with *roots*. Leaves small.
4. Ferns, *leaves large*, no seeds.
5. Cycads and Ginkgo, naked *seeds*, sperms swimming.
6. Conifers, naked seeds, sperms *not swimming*.
7. Dicotyledons and Monocotyledons, *seeds enclosed* in a fruit.

These various groups may be described more in detail as follows:

1. **Algae**. The blue-green algae and green algae live chiefly in fresh water and include the simplest forms. The bacteria are a distinct and probably very ancient group. Slime molds exhibit characters of both plants and animals. The brown and the red algae or seaweeds grow chiefly in salt water.

The **fungi** seem to represent several distinct side lines of development, characterized by absence of chlorophyll. Land forms such as **lichens** are doubtless very ancient, mushrooms comparatively recent. All these plants are called *Thallophytes*; they have no true leaves.

2. In the **liverworts and mosses**, life on moist land became possible by the development of small bottle-shaped structures

called **archegonia**, enclosing and protecting the egg-cells. When fertilized, the egg-cells develop into special structures (*sporogonia*), which produce spores. There is thus a distinct alternation of generations.

3. To grow on the "dry" land it became necessary for the plants to take up moisture from the soil. In the **clubmosses** appear absorbing **roots**, with root hairs, and a vascular system. The leaves are small, as in the mosses. The sperm- and egg-producing generation (the prothallium) is here comparatively inconspicuous. The sperms of clubmosses have two cilia, like the bryophytes; those of horsetails and the higher plants are multiciliate.

4. The nutrition of green plants requires the action of light. The **ferns** develop **large leaves**, with greater capacity for food making. These leaves have numerous spore-cases *on the under side*, while the smaller leaves of clubmosses have a single spore-case *on the upper side*. In the water-ferns (and also in *Selaginella*) there are two sizes of spores.

5. In the **seed-bearing plants** there are always two sizes of spores. In the ferns and lower plants the spores usually fall to the ground and there germinate and are fertilized. In the seed-bearing plants, however, the large spore remains in its place on the parent plant, germinates and is fertilized by the sperm from the small spore, brought to it by wind or insects. This results in the production of a **seed**, which is really a young plantlet (with surrounding structures) capable of remaining in a dormant condition for a considerable time.

6. The cycads and ginkgo, like the algae, mosses and ferns, have swimming sperms, thus needing water for fertilization. In the **conifers** and angiosperms the sperms are **not swimming**.

7. The lower seed-bearing plants, or gymnosperms, have naked seeds. In the angiosperms, which are the true flowering plants, the **seeds** are **enclosed** in an ovary, which develops into a fruit.

The angiosperms form two main groups. The dicotyledons are nearest to the gymnosperms. They have two seed-leaves, leaves netted-veined, and floral parts usually in five's or four's. Within the dicotyledons, woody forms have usually the most primitive characters. The evolution of flowers occurs along many lines, from parts (sepals, petals, stamens or carpels) all separate to these parts more or less united. Other developments are from regular to irregular flowers, that is, toward increasing adaptation to insect pollination. In general, herbaceous plants and those with united petals have less primitive characters.

The monocotyledons are a side line with one seed-leaf, leaves mostly parallel veined, and floral parts usually in three's.

ALFRED GUNDERSEN.

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SCHOOL NUMBER

BROOKLYN BOTANIC GARDEN

LEAFLETS

SERIES X BROOKLYN, N.Y., SEPTEMBER 20, 1922. NO. 7

BULB CULTURE *

Bulbs are easier to raise in class-rooms and at home and give more pleasure than perhaps anything else in the plant world. Still, one must follow certain directions for their potting and culture if success is to be sure.

In the first place, certain kinds of bulbs are easier to raise indoors than other kinds. These should always be chosen in work with young children. The narcissus group is the most satisfactory of all for this work. Choose such members as paper white narcissus, poeticus, Von Sion, jonquils and Chinese lilies. These last are usually the least satisfactory because their blooms blast when exposed to the slightest of draughts.

Hyacinths come next in choice. They fall into two general classes, the Dutch and Roman varieties. The Roman ones bloom earlier than the Dutch. If tulips are chosen, order the early blossoming ones; for on the slower growing varieties, plant lice often develop. Crocuses do well indoors, especially when planted in masses. These, then, are the easiest to raise of all the bulbs for indoor work, and the ones most likely to give success.

Bulbs should be bought during September and October, for all potting ought to be over by the last of October. For this work with bulbs, have ready the bulbs, soil, sand, charcoal, broken crock, and the pots.

The Bulbs.—In the first place, order these of any good seedsman. If hyacinths be chosen, remember that the named varieties are more likely to give good results, but they are more expensive

* A second reprint of Brooklyn Botanic Garden LEAFLETS, Series I, No. 12.

than the unnamed ones. If one cannot afford the named varieties, order by color, such as the blues, whites, etc. Be sure to choose firm, solid bulbs. These have more strength to do their work; more food supply stored up. For, within the heart of the bulb the flower itself is already formed, ready to push itself up and out into the world when conditions are right. So the strong bulbs are better fitted for their work than the weaker ones. Remember this, too: that Roman hyacinths bloom earlier than other hyacinths, requiring a shorter resting period. Those planted in October may be had for Christmas bloom.

Soil.—The soil for bulb planting should not be too heavy. Heavy soil clings firmly together when moistened, due to clay in it. Light soil falls apart. If the soil seems to be a heavy one, lighten it with sand, adding about one-third sand to the amount required. Sand not only lightens soil, but it helps by carrying surplus water off. In very heavy soils, water may collect about the base of the bulbs. This causes decay. Free the potting soil from lumps and stones; if necessary, sift it.

Pots.—Bulbs may be planted in pots, pans or flats. Pans are low crocks. Flats are low boxes of about four inches in height. The bottom of a flat ought to have holes in it or spaces for drainage. Many bulbs can be planted in a single flat, just as closely together as possible. When the bulbs are almost ready to bloom they may be transplanted into separate pots. The number of pots to buy depends upon the number of bulbs. It is a matter of calculation. Bulbs need just enough space to grow in, without touching neighboring bulbs. Suppose the pot to be a five-inch one: allow two Dutch hyacinths to such a pot; three Roman ones; two Von Sion daffodils; two paper white narcissus; three poeticus; four jonquils; five tulips—or four if they be large ones; six to eight crocuses; and eight to ten freezias.

Method of Potting.—After all the materials are gathered together, proceed with the potting after this fashion. The hole in the bottom of the pot is for drainage and to allow air to enter and get at the roots. This is important, for roots must have air. To be sure, some air is bound up in the soil, but the roots need more than this. Hence, the hole in the bottom of the pot is for this

purpose, and should never be tightly clogged up. Place a curved bit of broken crock over the hole, with concave surface toward the hole. This covering prevents the soil from trickling through, or the water from passing out too fast; but it does not prevent the entrance of air. More air enters than if a flat piece of crock is placed directly across the hole. After this, put about an inch of drainage material in the pot, but less than this should go in

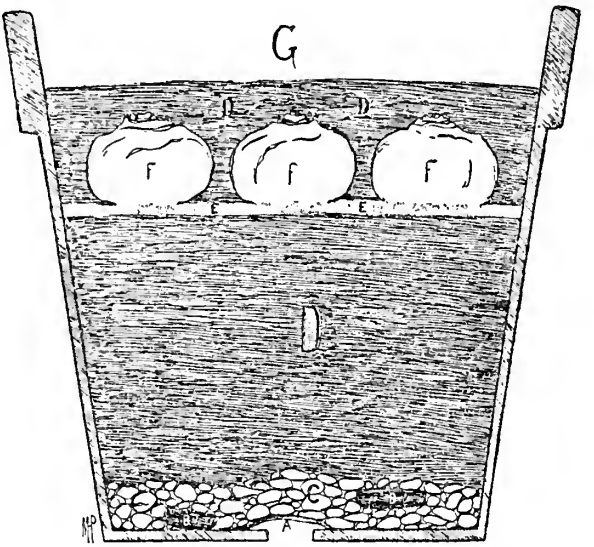

Fig. 5.—Longitudinal section of flower pot, showing arrangement of potting materials and bulbs. A, curved piece of crockery over drainage hole; B, charcoal; C, drainage material; D, soil; E, layer of sand; F, hyacinth bulbs; G, space for watering.

shallow pans and flats. Materials to use for drainage purposes are crock, turf or sod, charcoal or even stone. These are spoken of as drainage material, because a loose area is formed through which water slowly trickles, and at the same time the soil is not clogged with too much water. Charcoal may serve a double purpose, for it is thought by some to sweeten the soil. It is perhaps well to use a piece of charcoal in each pot when other drainage material is not used. One can raise bulbs successfully, of course, without using charcoal at all. The soil goes next after this layer.

Now comes another point to calculate, and that is the amount of soil necessary before putting in the bulbs. Find it out thus: hold the bulb to be used down into the pot so it is in the place it ought to be. Hyacinths should be potted so that their noses (the pointed end of the bulb is called the nose) are one-half inch below the surface of the soil; tulips, one-quarter inch below the surface; and the narcissus group above the soil. The upper surface of soil in a pot should be one inch below the edge of the pot. This space is allowed for watering, so that soil will not flood over the edge of the pot when water is put on. After this, put a little sand over the soil, a layer not more than an eighth of an inch thick. This sand bed acts as a drainage area, allowing water to trickle down and away from the bulb. Now place the bulbs in their sand beds. Leave just space enough between the bulbs so that no two touch. Neither should they touch the sides of the pot. Cover with soil, pressing it down firmly about the bulbs. Now they are ready for the season of rest.

Resting Period.—All potted bulbs should be placed in a dark, cold place for six to ten weeks. Roman hyacinths may be brought in after a month's rest. The object of this resting period is to give time for the roots to develop slowly and surely before the plants are brought into the light. For as soon as this time comes, a bulb expends all its energy in forcing the flowers and leaves, so the work of root making must be done before this time. If the roots are not properly developed, good results cannot be expected. The roots are properly developed when they begin to force their way out of the hole in the bottom of the pot. The pots may be stored for this resting period either indoors or outdoors. If they are to go indoors, select a cold, dark place, such as a cool cellar or basement. The bulbs must be watered once or twice a week. If they are to go outdoors, one of two methods may be employed. Either dig a trench in the ground for them; or prepare a box. If a trench is dug, it must be at least eighteen inches deep, and wide enough to take in the widest receptacles. Place two inches of coal ashes on the bottom of the trench. This layer assists drainage and offers an obstacle in the path of ascending worms. Now the pots of bulbs are placed on the ashes and soil put all about and above them. Fill in the rest of the trench with soil or coal

ashes. Coal ashes form a looser layer than that made by soil, so it is easier to shovel off the ashes in cold weather. Never use wood ashes, because of the lye in them, which, trickling down to the bulbs would kill them. Leave them thus until you wish to take them in. But allow six weeks for development. Nature does the watering. The second method, that of using a box, is an excellent one for use in schools. Get a box of the size you wish; it should have a depth of at least two feet. Put an inch layer of sand, soil or ashes over the entire bottom of the box, placing the pots on this. Cover the pots in the box with sand and then fill the box full with coal ashes. In extreme weather put a covering over the box which is left outdoors, on the ground or on a roof. Again nature does the watering. The box may be lined with a heavy wrapping paper, which insures greater warmth. Be sure to mark the pots with wax crayons. This is very essential in school work, so that children may receive their own pots.

Care of Bulbs.—When the pots come out of the darkness, do not immediately bring them into direct sunshine. Let this be gradual, first leaving them in a darkened part of a room, and finally when the buds begin to open, see that they receive the direct sunlight. Water freely, for it helps the blossom to unfold. Never let a pot stand where a draft strikes the plant, or the blossoms will blast before unfolding. After the period of bloom is over, let the blossoms, leaves and all, completely wither up. Then cut the stalks back to one inch from the bulb itself. Shake all soil from the roots and place the bulbs in the sunshine to dry out. Pack away in tin boxes. These bulbs may be planted outdoors the following fall; they are of little or no value for further work indoors, for they rarely give satisfactory blossoms. Chinese lilies can never be used again after one period of blossoming.

Water Culture.—Some bulbs will grow well in water, pebbles and water, or sand and water. Hyacinths do well in tall glasses which the florists and seedsmen sell for this purpose. Fill the glass with water, place the hyacinth in the top of the glass with the pointed end of the bulb up. Now place the glass away in a dark closet, but not necessarily a cold one, until the hyacinth's roots are way down to the bottom of the glass. Then it is time to bring it to the light. Chinese lilies and other members of

the narcissus group may be planted in pebbles and water. The pebbles are placed in the bottom of the glass dish or earthen one. Upon this layer, place the bulbs, two to an eight ounce dish, and surround them with pebbles for the purpose of steadying the bulbs. Water should be poured in so that it just touches the base of each bulb. These dishes of bulbs ought to go into a dark closet until good root growth has developed. Paper white narcissus, Von Sions and poeticus may be buried in a bank of sand, but leave the noses of the bulbs sticking out of the sand. Treat these as you would those planted in pebbles and water, except that the entire sand mass must be always saturated with water.

Outdoor Planting.—An outdoor bulb bed is excellent for school grounds, being decorative and easy to plant. Tulips look well in round beds planted in one color masses. Border beds may be filled with daffodils or hyacinths. Crocuses, snowdrops, and little grape hyacinths are planted here and there in the grass. The single flowered varieties of bulbs are more attractive than the double flowering kinds. In preparing an outdoor bed be sure that the soil is dug up and made fine for a depth of eight inches. Different bulbs are planted at different depths. Hyacinths should go six inches beneath the soil and six inches apart; narcissus and tulips, four inches down and four apart; crocuses three inches deep and three apart; all small bulbs, like snowdrops, etc., should go only just beneath the surface of the soil. Cover the bulbs over with soil. When the weather becomes cold and just before frost, put about two inches of barnyard dressing (horse manure) over the beds. Later, as the weather grows colder, put a piece of sacking or heavy wrapping-paper over each bed. Hold these down with stones so that the wind does not blow the covers away. This last cover is not an absolute necessity. When the spring comes, take away whatever remains of the coverings and see the tips of the bulbs poking out of the ground. For outdoor planting, buy "bedding" varieties. Do not wait until late October or November to buy bulbs, for they lose value during the fall, shrinking and becoming less strong. The outdoor bulb bed may be left as it is after blossoming time. That is, the bulbs may be left in the ground, and the

tops cut off. Of course, all the bulbs could be dug up, dried, and planted out again the next fall. These bulb beds should have new bulbs put in about once in four years.

ELLEN EDDY SHAW.

THE GARDEN COLLECTION OF PERENNIAL ASTERS

The perennial asters in the collection brought back from England last year by Mr. Montague Free, Horticulturist of the Brooklyn Botanic Garden, are just now coming into flower, and show most interesting and striking variations in color, size and shape of petals, as well as in the general habit of the plant. In all there are about seventy-five varieties represented here, ranging in color from purple and blue to pink and white. The colors are perhaps not as vivid as one finds sometimes in our native forms, but unusual hues have been developed, especially a shade of pink of great beauty. The plants were obtained in the summer of 1921 by Mr. Free, from Aldenham House Gardens, near London, on the country estate of Hon. Vicary Gibbs, son of the late Lord Aldenham. They were set out last fall in carefully prepared soil in the bed bordering the east side of the walk leading from the Laboratory Building to the Children's Gardens. The varieties of *Aster novi-belgii*, the New York aster, and *A. novae angliae*, the New England aster, are now at their best, with striking showy flowers of various shades of violet purple. King George, a variety of *Aster Amellus*, at the extreme north end of the bed, with slender, pale-blue petals, about one inch long, has nearly finished its blooming period.

It is interesting to note that English horticulturists have paid particular attention to the cultivation and hybridization of our our native asters. The collection at the Brooklyn Botanic Garden is a good illustration of what has been done in England along this line. In general, besides the development of the different color shades, cultivation has resulted in increased size of the whole plant as well as enormous productivity. In fact, simply for lack of room, it would seem impossible for some of the plants to have any more flowers. Some of the smaller, white-flowered forms are studded all over with diminutive, fairy-like blossoms which, contrasted with the green of the leaves, give a pleasing effect although not so striking as in the large-rayed varieties. Each wee blossom is, however, a thing of beauty in itself, like a tiny star—so that the name *aster*, the Greek word for star, is most

appropriate. Most of the varieties in the Garden collection were derived originally from American stock; a few, however, came from a European and Asiatic species, *Aster Amellus*.

Our native asters, lavishly displayed all about us at this season in woods and fields, deserve more attention from local plant lovers. Their cultivation is easy, and they improve greatly under domestication. If it is desired to multiply some particular variety, propagation is readily affected by division of well grown rootstocks or even by cuttings, for in this case it is unsafe to trust to seed.

The much cultivated China aster, which is an annual plant, raised from seed each spring, is not a true aster at all; yet many people have this in mind when speaking of asters. It is a form of *Callistephus hortensis*, a native of China, and, like the Chrysanthemum, has proved to be capable of remarkable variations. The true asters belong to the genus Aster, and are for the most part perennial, their rootstocks remaining alive underground through the winter from year to year.

ARTHUR H. GRAVES.

DOCENTRY

Throughout May and June, and September and October, for the assistance of visitors in studying the collections, a docent will leave the front door of the laboratory building every Monday, Wednesday, and Friday (weather permitting) at 3 p.m., as per the following schedules:

Fall Schedule

Monday	Japanese Garden Wild Flower Garden
Wednesday	Rock Garden Conservatories
Friday	Herbaceous and Shrub Garden Ecological Garden

The service is free to members of the Botanic Garden: for others there is a nominal charge of 10 cents a person. No trips will be taken for parties of less than six adults.

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BROOKLYN BOTANIC GARDEN

LEAFLETS

SERIES X BROOKLYN, N.Y., OCTOBER 4, 1922. NO. 8

THE FORESTS AND SOME BIG TREES OF LONG ISLAND

At a court of assize in New York on April 7, 1672, it was ordered that "four days every year the inhabitants of Long Island from sixteen to sixty years of age shall be obliged to go into the woods to cut the small brush and underwood, and any person failing, to pay a fine of fifty shillings." From that day to this, and particularly since the advent of the railway in 1844, there have been periodical disturbances of the forests of the island, usually followed by disastrous fires. This early cutting of the young woods was practically universal in all Long Island towns, many of which passed still more stringent laws to see that it was accomplished. Too late, they nearly all, as historical records amply prove, reversed the policy.

The forests of the island, then, have been subject to so much attention by zealous, if rather ruthless, ancestors of ours, that only by studying relics which escaped their ministrations can we get any idea of the true forest possibilities of the Island. Such a study has been made at Gardiner's Island, where there is perhaps the finest growth of timber to be found within hundreds of miles of New York. On a given acre there are sixteen trees nine feet or more—usually much more—in circumference; and many times that number between six and nine feet in circumference. This shows what freedom from fire and cutting will do; since it was in 1639 that the first Lion Gardiner reached the island. It has been in that family ever since, and furnishes an unique example of intelligent and continuous ownership.

For the rest of Long Island there are dreary miles of third or fourth growth timber to reward the seeker after forest data. The writer has travelled hundreds of miles over the Island gathering information which might lead to a possible utilization of its timber possibilities. This has involved a study of the trees themselves, the climate, particularly the evaporating power of the air, the soil, and most important of all, the rate of growth of the different native trees on different sites.

But no information gathered by a single individual could possibly assemble all the needed data, so that in March of this year it was decided to offer prizes for records of big, native trees. From over three hundred records sent in, a mass of information

has resulted, and the contest has almost automatically succeeded in straining out of the great bulk of indifferent tree records the survivors of the ancient regime, already mentioned.

Discarding, for the purpose of this leaflet, all records of trees less than nine feet in circumference, the records show the following proportion of different kinds of trees:

Oaks (all kinds)	56	Tulip-tree -	4
Plane tree - -	15*	Beech - -	3
Black Walnut -	14	Linden - -	3
American elm -	14*	Ash - -	1
Red Maple -	9		

These figures merely confirm the generally known fact that where a forest does grow on the island, it is predominantly an oak forest, except in the great central pine-barren region. No records of wild trees have come from this area, as the predominant pitch-pine (*Pinus rigida*) does not reach such dimensions on Long Island. That large, sandy tract appears to be little changed from the day when General Washington rode from Patchogue to Coram and Setauket (22nd April, 1790), and wrote in his diary that the country was "too poor to admit inhabitants or cultivation, being a low scrubby Oak, not more than two feet high, intermixed with small and ill thriven Pines."

Practically all the big tree records, and the forest of which most of them are relics, are found along the north side of the Island, or along the narrow belt of deciduous forest that fringes the succession of bays on the south shore. In overwhelming proportion they come from the glaciated parts of the Island, where the soil is richer, and has on the whole a higher moisture-holding capacity, and where there is some freedom from the tremendous winds that sweep shoreward from the ocean during the trying summer months.

The largest trees are, generally speaking, oaks; the white, red and black oaks being predominant. The circumferences of some of the largest, taken five feet from the ground, and the locations of the specimens are as follows:

White oak:	19 feet, 7 inches;	Stony Brook.
White oak:	17 feet, 8 inches;	South Huntingdon.
White oak:	17 feet, 4 inches;	Glen Cove.
White oak:	17 feet;	Locust Valley.
Red oak:	17 feet;	Lloyd's Neck.
Black oak:	16 feet, 6 inches;	Locust Valley.

There are many more from nine to sixteen feet in circumference.

The plane tree, or sycamore (*Platanus occidentalis*), which has the biggest trees of any deciduous species in North America, also has the distinction of yielding the largest Long Island tree.

* Many of these are planted trees, for most of the records come from parts of Long Island where the elm and plane tree do not grow as wild trees.

The biggest sycamores are:

24 feet;	Wheatley.
18 feet, 4 inches;	St. James.
16 feet;	Northport.
14 feet, 4 inches;	Hempstead (quite certainly planted).

Of the tulip-trees reported, only one is large; that at Great Neck, which is eighteen feet in circumference, and obviously decaying. Unfortunately it has suffered from the effects of unskilled "tree surgeons" in the past, and this treatment has undoubtedly hastened its decay.

Large black walnuts have been reported as follows:

15 feet, 10 inches;	Cedarhurst.
15 feet, 9 inches;	Mill Neck.
15 feet, 6 inches;	East Norwich.
15 feet;	Valley Stream.
14 feet, 10 inches;	Glen Cove.

All of these are much smaller than the black walnut that stood, until a few years ago, on the William Cullen Bryant place at Roslyn, and was reported as twenty-nine feet in circumference.

The largest red maples, of which only a few records were submitted, are as follows:

14 feet;	Sag Harbor.
12 feet, 7 inches;	Manhasset.
11 feet, 3 inches;	Greenport.
11 feet;	Woodbury.

The only lindens reported are all from the eastern end of the Island, the largest being:

15 feet, 3 inches;	Orient.
12 feet, 9 inches;	between Sag Harbor and Southampton.

The American Elm, which is native at only a few places, all on the north shore of the Island, and mostly from the western end, netted the following:

15 feet, 11 inches;	Plandome.
15 feet, 2 inches;	Oyster Bay.
14 feet, 7 inches;	Whitestone.
13 feet, 7 inches;	Cold Spring Harbor.
13 feet, 6 inches;	Easthampton (surely planted).
13 feet, 2 inches;	Glen Cove.

The three biggest trees on the Island, so far as our records show, are as follows:

Platanus occidentalis, or sycamore, 24 feet in circumference, on the property of James N. Hill, at Wheatley.

Quercus alba, or white oak, 19 feet, 7 inches in circumference, on the farm of Paul Costermale, at Stony Brook.

Platanus occidentalis, or sycamore, 18 feet, 4 inches, on the property of E. J. Brennan, at St. James.

There is an interesting history in connection with the largest tree reported. Mr. Hill writes in part as follows:

"Ninety years ago the so-called Big Tree Farm (the location of the present sycamore tree under discussion) was used by the county butcher as his home; and the beef slaughtered were hung on chains, suspended from a limb, one of which chains remained on the limb when I bought the place. During the past 105 or 120 years, after the forests were cut away and the land in the neighborhood was put under plow, the soil from the neighboring hills was washed down and filled in around the tree to the extent of fourteen feet. This statement was verified some six years ago, when I had a tree expert give a very careful overhauling to the big sycamore tree, during which overhauling he carted away three wagon loads of rotten wood and removed one large branch, about two feet in diameter and hollow, which hollowness was filled with honey. He then tied the branches of the tree to the central branch so that the wind could not break them. He also dug a trench some ten feet from the tree, and found no roots until he had gone down fifteen feet, at which place he put in some good soil and fertilizers. The tree responded to the treatment and has been growing in healthy condition ever since."

The contest has brought in a wealth of information which it will take much time properly to digest. The Brooklyn Botanic Garden is greatly indebted to the contestants, and to many disinterested observers for their hearty cooperation.

NORMAN TAYLOR.

To Reach the Garden take Broadway (B.R.T.) Subway to Prospect Park Station; Interborough Subway to Eastern Parkway-Brooklyn Museum Station; Flatbush Avenue trolley to Empire Boulevard; Franklin Avenue, Lorimer Street, and Tompkins Avenue trolleys to Washington Avenue; St. John's Place trolley to Sterling Place and Washington Avenue; Union Street and Vanderbilt Avenue trolleys to Prospect Park Plaza and Union Street.

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THIS NUMBER COMPLETES SERIES X, 1922.

BROOKLYN BOTANIC GARDEN

LEAFLETS

SERIES X BROOKLYN, N. Y., OCTOBER 18, 1922. NOS. 9 AND 10

FERNS AS HOUSE PLANTS[1]

Ferns! What does the word bring to mind? To me it recalls the outdoors; woodland, streamside, mountain slopes. Ferns suggest tropical forests and jungles; or, to let the thought run back in time, ferns call up vistas of ancient vegetation when no flowering plants existed. Then ferns were the predominant plant type, and from the dead ferns and similar plants of that period, by some extraordinary reduction process, we have coal.

But ferns are not merely denizens of the wild, remote and untamable. They are a common sight along city streets, in store windows. Retail florists' shops show dozens of plants. Commercial growers throughout the country raise literally millions of fern plants every year, and these find their way eventually into hundreds of thousands of homes. What characteristics have ferns that make them the most successful of all house plants?

If you will let your thought seek for a moment the distinguishing feature of ferns, you will realize that their individuality is expressed almost entirely in their leaves. The word "fern-like" presents a picture of a feathered leaf, with serried leaflets along two sides of a median stalk. Such a leaf may be long and narrow, or short and broad; the division may be reduplicated several times, but always the feathered cutting suggests a fern. As a matter of fact, ferns offer also leaves of all imaginable shapes, simple and undivided, hairlike or broad, mosslike or leathery, clinging, et al.

[1] Reprinted from AMERICAN FERN JOURNAL, Vol. 12, No. 3, 1922.

Ferns as house plants offer, then, leaves in infinite variety of shapes, of types of division, of shades of green. Some are even variegated with white, red, and other colors. Thoreau's characterization, "Nature made ferns for pure leaves," cannot be too often quoted. To it may be added the fact that although Nature made ferns millions of years ago, she has never since surpassed the beauty of the fern leaf type in the leaves of later manufacture. Secondly, a good house fern is continuously beautiful throughout the year. It does not depend for its attractiveness upon the occasional production of transitory flowers. Such a fern plant will last longer, even in the unfavorable conditions of a dwelling house, than practically any kind of flowering plant.

Care of Ferns in the Home

Success with plants in the home—ferns or any other plants—is really a matter of human nature. Do you admire and appreciate the beauty of a living plant? Besides a simple esthetic appreciation, do you realize that a plant is a living, growing being—an eating, breathing, drinking, feeling organism, which thrives or pines according to its environment and the care it receives? Can you take enough interest in a plant pet to study and understand its few and simple needs, and systematically to supply these, a daily drink of water, good light, pure air, cleaning, and an occasional new supply of soil food and root space?

With many people, particularly in cities, a plant is mainly a means of temporary decoration, to be used like a picture or hanging, according to the needs of the room. They would like to have it remain beautiful indefinitely, but—"I don't know what is the matter. I can't seem to make plants grow." Under the frequently unsatisfactory conditions of city homes no one can make plants grow successfully. With poor light, gas fumes, and overheated rooms, it should be thoroughly understood that plants are to be considered merely as temporary decorations, like flowers, but lasting weeks or months

where flowers last days. If the place to be decorated happens to be a well lighted window, and the plant receives a daily drink, it may surprise its hosts by refusing to die even months after its arrival, but it will probably wear out its welcome in its cumulative decrepitude.

In the country and in smaller cities especially, there are those who like to try to *grow* plants in their homes just as others keep birds, dogs, cats, or other animal pets. Their idea is not so much that here is a dark corner in which a plant would look well, or here is a dining table (in the middle of a dark room) which needs a plant centerpiece. Some people like plants. They enjoy trying to keep them growing successfully from one year to the next. With that point of view, the arrangement of the room becomes secondary to the interests of the plants. These are given the best window in the house, without intervening curtains. Their care is as much a matter of the daily routine house work as the preparing of meals, etc.

As a matter of fact, both viewpoints may be justifiable. House plants are beautiful as part of the scheme of home adornment, even though they require replacement at rather frequent intervals. They are also interesting as living things, to be cared for and studied.

The essential principles of house plant care have already been indicated above. Applied to ferns, and reduced to definite rules, they may be stated as follows:

1. Water regularly, a little every day. Do not let the plant become dried out. A parched fern looks gray and dull, and droops. Do not keep the soil so wet that it is muddy. When a fern has "wet feet" continually, its leaves turn yellow.

2. Keep the temperature moderate, not over seventy, nor under fifty, unless the plant is semi-hardy, as will be described below. Ventilate the room if gas is used, but do not stand the fern in strong drafts.

3. Clean the leaves if they become dusty or buggy. The leaves are best washed when the air is such that

they will dry off quickly, though not in hot summer sun.

4. Give the plant the best lighted window in the house, a sunny window except perhaps in the hottest summer days. The florist often grows his ferns in full sunlight the year around, but he keeps the air moist, a condition not possible in houses. Do not rotate the plant with the idea of making it develop symmetrically. All the new leaves will be under-developed, and only those toward the light will benefit by the light at any one time. You have never seen leaves growing naturally facing away from the light.

5. If all the preceding requirements have been met, the fern should increase gradually in size until it becomes rootbound. Repotting is best done in May or June, and if the plant can then be plunged into the soil, pot and all, in a shady corner of the yard, the summer out-of-doors will be reinvigorating, and the new growth strong. During the year, fertilizer may be given in the form of weak sodium nitrate solution, Clay's fertilizer, or any leaf food.

The first three rules are concerned merely with maintaining the fern in the condition received as long as possible. The last two rules have to do with the quality of the new growth. With the conditions of the florist's greenhouse as ideal, the aim should be to make the home environment approximate as nearly as possible the ideal. The resulting plant will be a compound of three factors, the individuality of the plant itself, the environment supplied, and the personality of the owner of the plant.

The Best Kinds of House Ferns.

Since the question of house plants is of particular interest to the home maker, I asked the arbiter of a home in which I am acquainted just what she wanted to know about ferns as house plants. "How they look and how they last," was the answer which really epitomizes the whole problem of selecting house plants in

general. What ferns look best, are most decorative? Which kinds last, remain decorative for the longest time?

The matter of looks is largely one of personal taste. Different people fancy different types. Among the forms illustrated and described a wide variety exists. Some are smooth, some ruffled; some are dark green and glossy; others paler with dull surface. Some may grow to a height of two to four feet or more; others never become more than a foot tall. Some are divided in typical feathery fern fashion; others are tasselled, forked, or otherwise subdivided. One not uncommon in florist's establishments, though not shown here, has simple sword-shaped leaves (bird's nest fern). All are attractive in appearance.

One further point as to culture may be made. The florist divides cultivated plants in general into four classes according to their temperature requirements, viz.; "hardy," "semi-hardy," "greenhouse," and "stove," the latter requiring the highest temperature. The ferns suitable as house plants all belong in the second or third class.

Ferns classified as semi-hardy come originally from warm temperate regions, where they were accustomed to rather cold winters. For this reason they do best when allowed to rest most of the winter, and they are well suited to be kept in rooms which are kept fairly cool, with the windows opened perhaps at night as in sleeping rooms, provided the temperature does not go below freezing too long. Some of them do well in an outdoor garden from Philadelphia southward.

The other class, the so-called "greenhouse" ferns, hail from subtropical climates, like southern Florida. At home their growth slackens during winter but does not entirely stop, and they cannot stand temperatures below forty. Even below fifty is undesirable.

In general, the semi-hardy kinds make tougher, better lasting leaves, which stand up even under neglect for a long time. The tropical varieties form fuller, more compact plants, and continually replace older leaves

with new fresh ones if growth conditions are sufficiently good.

The semi-hardy varieties illustrated in this paper are all included in three genera, *Dryopteris*, *Polystichum*, and *Cyrtomium*. Among the sub-tropical forms, ten genera are represented. The names used are based on the recently adopted standardized list of cultivated plant names which has been adopted as official by the various florists' associations and other organizations. At present, the trade nomenclature of common cultivated plants is in a sad state of confusion, but the newly determined list is a long step toward uniformity, though it will take considerable time before the information is assimilated throughout the body of commercial florists at large.

Semi-hardy varieties

Cyrtomium falcatum (Plate 3, figure 1). Holly fern.

The variety illustrated is var. *Rochfordianum compactum*, introduced by Dreer, a dwarf sport of the Rochford variety brought out in England. Another variety, *Mayi*, has forked and crested leaf tips and pinnae. Any of these holly fern varieties are excellent for the house; lasting, as well as beautiful. The leaves grow in a circle from a scaly crown, after the fashion of our wild Christmas fern, but the pinnae of the holly fern are much broader, and in the Rochfordianum, beautifully ruffled and lobed, dark glossy green, one to two feet long. Native in Pacific Islands and Asia.

Polystichum adiantiforme (*P. coriaceum*, a better known name). (Plate 3, figure 2.) Leather fern.

Another excellent house fern, to which the illustration does less than justice. It is tall-growing, with a creeping, scaly stem; the leaves, which may reach two to three feet in height, are triangular, three- to four-pinnate, and extremely tough and lasting. It has been planted in Florida to some extent for use in the cut-leaf trade. Native in South Africa.

Polystichum tsus-simense (*P. "tensemense"* as sometimes corrupted in the florist's trade). (Plate 3, figure 3.) Tsusima holly fern.

A small fern, twelve to fifteen inches high, forming compact clumps of several tufted crowns of leaves. The leaves are rather dark green, dull, twice pinnate, erect. With *Cyrtomium*, it is one of the commonest ferns grown as "table" ferns, for filling baskets and fern dishes. Native in Japanese islands.

Dryopteris viridescens (Plate 3, figure 4). Glossy wood fern.

Offering perhaps the most beautiful leaves of the entire list. The leaves develop in a circle, are three pinnate, one to two feet long, pale green at first, with spinulose segments. It is of the type of our wild *D. intermedia*, though well distinguished. Native in China.

Dryopteris Sieboldii (Plate 3, figure 5). Siebold's wood fern.

An odd triangular-leaved fern, with a few large broad pinnae. In the fertile leaves the pinnae are contracted. The leaves spread horizontally, and are about a foot long at most, dull, pale green. Native in China and Japan.

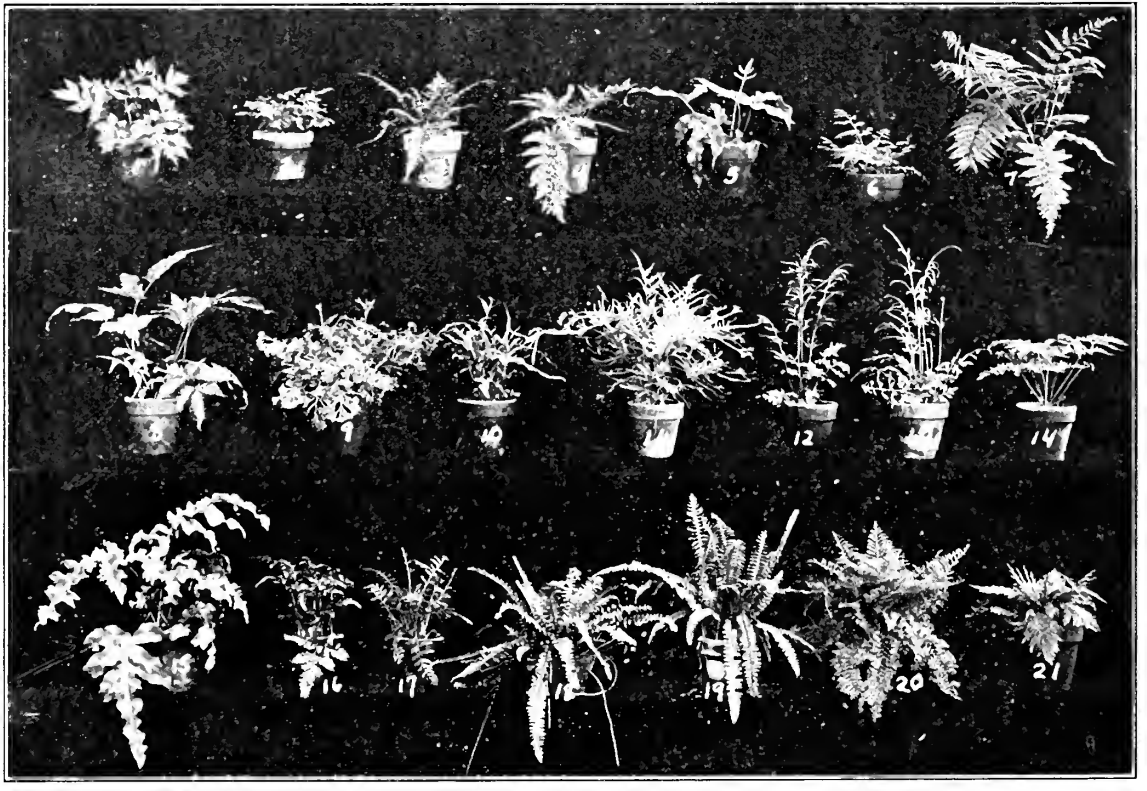
Sub-tropical varieties

Adiantum cuneatum (Plate 5, figure 7). Delta maidenhair.

Probably more people have heard of maidenhair ferns than of any other single kind. Our common wild species is only one of over a hundred species, nearly all of which are tropical. Of all the species, *A. cuneatum*, in some of its varieties, is best adapted to house conditions, but its leaves have such a thin, delicate texture that success cannot be promised, although plants may be kept for some time. The plant illustrated is known as var. *California*. Native in South America.

Davallia solida (Plate 3, figure 16 and plate 4, figure 2). Glossy davallia.

Davallia is best known for two other Japanese species formerly sold commonly as "fern balls," i.e., bundles



Twenty-one Ferns for the House, Shown in Small Plants.

of rhizomes in a resting condition, made up with moss and starting into growth with watering. The species illustrated has a harder glossier leaf, triangular, tripinnate, about a foot long at most, from a creeping rootstock, and make a very attractive little plant. Native in Polynesia and Australia.

Asplenium auritum (Plate 3, figure 17 and plate 4, figure 3). Spleenwort.

A little, bipinnate species, with slender divisions, the leaves growing about a foot at most. Not a recognized house fern, but included here to illustrate the genus. A more common, cultivated asplenium, the bird's-nest fern, *A. nidus*, was not available in small size. Native in American tropics.

Nephrolepis cordifolia (Plate 3, figure 19 and plate 4, figure 5). Tuber fern.

A good house fern, though not so well known as the following. The leaves are narrow, usually with blunt pinnae, dull, pale green, erect and spreading. One form has scaly tubers of the size of walnuts. The leaves are particularly resistant to drying, retaining their form under conditions which would cause many fern leaves to wilt and die. Native in tropics.

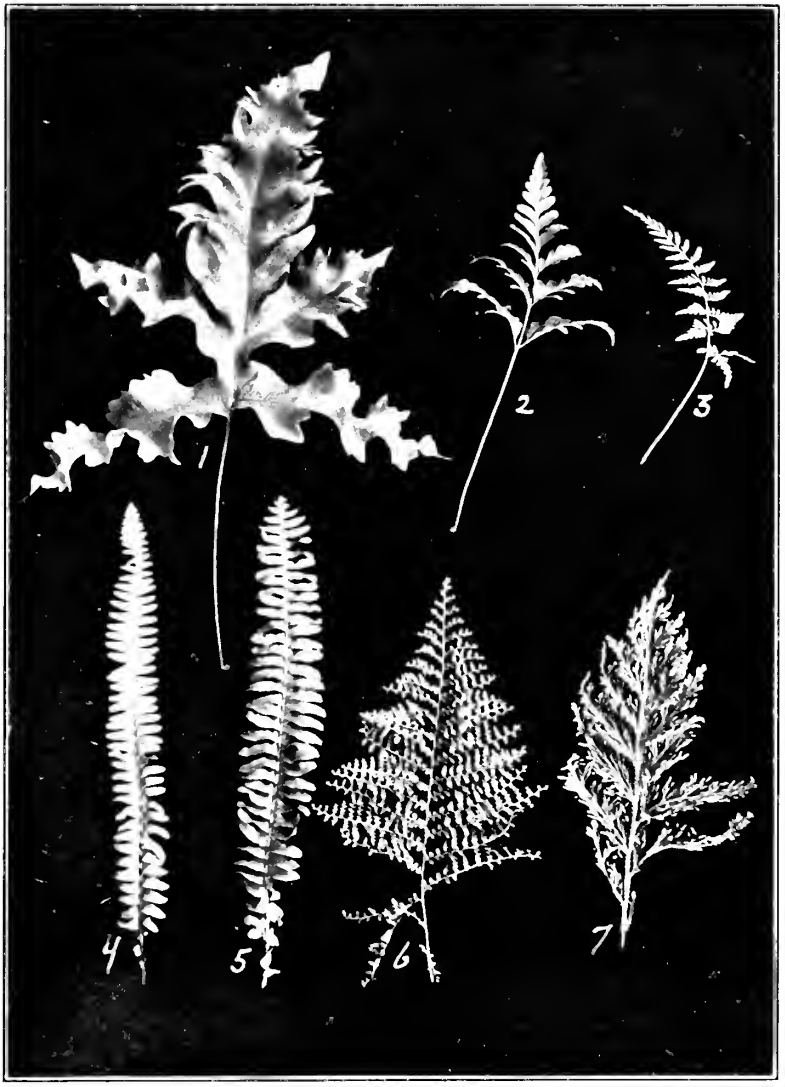
Nephrolepis exaltata. Sword fern.

No description of house ferns would be complete without the inclusion of varieties of the sword fern or rather, its variety, *bostoniensis*, deservedly the most widely grown of all cultivated ferns. Although not as hardy as the holly fern and others of that type, the stronger Boston fern varieties do well under house culture, and may be continued year after year with proper care. With one hundred named forms to choose from, the present article shows only two of distinct type. Native in tropics generally.

"Mills' Boston" (Plate 3, figure 18 and plate 4, figure 4).

A new, compact, once pinnate variety, less than one-third the size of the Boston fern itself, but adapted in

PLATE IV.



1. Bear's-foot Polypody. 2. Glossy Davallia. 3. Eared Spleenwort. 4. Mills' Boston Fern. 5. Tuber Fern. 6. Verona Fern. 7. Emmel Selaginella.

its size to smaller space, and particularly good because of its tough, lasting leaves.

Verona fern. (Plate 3, figure 20 and plate 4, figure 6.)

A three-pinnate variety of Boston fern, probably the best of the lace type for house conditions, and commonly offered in the trade.

Onychium japonicum (Plate 3, figure 6). Carrot fern. Japanese claw fern.

The carrot fern is a delicately pretty little species, sometimes sold as a table fern, but unsuited to ordinary house conditions. It would succeed better in a Wardian case or under a large bell jar. The leaves are slender, three-pinnate, with narrow segments, suggesting somewhat a carrot leaf. Native in Japan, China, Java, etc.

Pellaea viridis (*Pteris adiantoides* of trade.) (Plate 5, figure 6). Green cliff-brake.

Tall-growing, one to two feet, two- to three-pinnate, with dark brown, wiry, stalks and midribs, and dark dull green, ovate, segments. A commonly sold table fern which will grow in the house with reasonably good care. Native in South Africa.

Pityrogramma Martensii (Plate 3, figure 7). Gold fern.

The particular gold fern which was available for illustration is very sensitive and not suitable for house use, but there are two or three hardier species which may be counted possible house plants. They are:—*P. triangularis*, California gold fern; *P. sulphurea*, Jamaica gold fern; and *P. tartarea*, silver fern. They are easily distinguishable by the covering of yellow or whitish powder on the underside of the leaves.

Polypodium aureum (Plate 3, figure 15 and plate 4, figure 1). Bear's-foot fern. Golden polypody.

This tropical American species, occurring in Florida, is not well known as a house plant, but will succeed

PLATE V.

1. Ribbon Brake. 2. Alexander Brake. 3. Wilson's Brake. 4. May's Brake
5. Riverton Brake. 6. Green-Cliff Brake. 7. Delta Maidenhair.

none the less with ordinarily good care. The ruffled variety illustrated, var. *Mandianum*, Manda's polypody, is most attractive. Under greenhouse conditions, the leaves will reach a length of six feet, arising separately from the creeping, scaly rootstock, but in the house, it will not grow so tall. Native in American tropics.

Pteris cretica (Plate 3, figure 10). Cretan brake.

After the Boston fern varieties, next most common house fern types are found in the genus *Pteris*, and *P. cretica* offers the most varieties. They will generally grow well under the conditions proper for the Boston fern, but require more top light to make well shaped plants. Native in Europe and Asia; and in Florida. The following varieties are among the best:

albolineata (Plate 5, figure 1). Ribbon brake.
Like the wild form, except that through each leaf division there runs a distinct white line of variegation.

Alexandrae (Plate 5, figure 2). Alexandra's brake.
A crested form of the preceding, with tasselled tips.

major, (Plate 3, figure 10). Plain green, about like the species.

Mayi (Plate 5, figure 4). May's brake.
A crested, variegated form, with the leaf divisions forking lower than in *Alexandrae*.

Rivertoniana (Plate 5, figure 5). Riverton brake.
Has broad full pinnae, irregularly lobed and ruffled.

Wilsoni (Plate 5, figure 3). Wilson brake.
One of the most commonly grown varieties, clear green with tasselled tips, forming a compact plant.

Wimsetti multiceps (Plate 3, figure 11). Wimsett brake.
Somewhat like *Rivertoniana* but with tasselled tips, and narrower pinnae.

Pteris ensiformis (Plate 3, figure 12). Sword brake.

Grown mainly in the variety *variegata* or *Victoriae*, Victoria brake or "Queen fern" (Plate 3, figure 13), but also in a ruffled variety, *Sieboldi*, Siebold's brake (Plate

3, figure 13.) It is an interesting little species, with dimorphic leaves, the fertile always much taller, and erect. Used by florists to give variety in height in baskets and fern dishes. Native in Asia.

Pteris quadriaurita argyraea (Known in trade as *P. argyraea*). (Plate 3, figure 8.) Silver brake. Striped brake.

A very attractively variegated variety which will reach three feet or more under greenhouse conditions. Not easy for house culture. It is used by florists in small sized plants for its color effect in connection with plain green ferns. Native in eastern Asia.

Pteris multifida (*P. serrulata*, the best known name) (Plate 3, figure 9). Spider brake.

Similar to *P. cretica*, but with much narrower divisions of the leaf. The variety illustrated, *cristata*, crested spider brake, is beautifully tasselled. There are numerous forms, some variegated. Native in Eastern Asia.

Pteris tremula (Plate 3, figure 14). Australian brake.

A large species when full-grown, but mainly in small sizes. It is easier to grow than *P. quadriaurita argyraea*. The leaves are clear green, divided somewhat after the fashion of our wild brake, *P. aquilina*. Native in Australia.

Selaginella emmeliana (Plate 3, figure 21, and plate 4, figure 7). Emmel selaginella.

The selaginellas are not ferns in a true sense, although they are often grouped with ferns, both horticulturally and botanically. The genus includes some of the most beautifully colored of all vegetative plant growths, some showing various colors with an iridescent sheen. *S. emmeliana*, and its yellow form, *aurea*, are rather common with florists, and will stand house culture if the water supply is never neglected. Parched for a day, however, they wither and lose their beauty, although they will make a good new growth after some time. In the illustration (Plate 4, figure 7) what appears to be a leaf is really a "frond" in the original meaning of that term,

that is, a leaf-like structure, made up of a branching stem with numerous small leaves.

The twenty-eight varieties just described do not by any means exhaust the different kinds grown in this country by florists, and useful as house plants, but they will serve to give a general idea of what is available. Eighteen of the twenty-eight were obtained from one grower who specializes in ferns (Dreer of Philadelphia) as representing his stock. The others were added from the Brooklyn Botanic Garden collection to give a greater variety. The pictures show plants practically all in uniform sized pots, and are intended to afford a comparison of the various kinds at about the same stage of growth. In some cases the small plants give a very inadequate representation of the character of the forms concerned. However, with pictures and description combined, readers should be able to make a preliminary determination of their preferences. Since the plants are generally offered by retail florists in even smaller sizes, the illustrations should better serve the purpose of identification than would pictures of fully developed plants.

R. C. Benedict.

An exhibition of all the ferns illustrated in this paper and also of a considerable number of other kinds of house ferns is on view in House No. 10 of the conservatories of the Brooklyn Botanic Garden. These conservatories are open to the public April 1 to November 1, 10 a. m.–4:30 p. m. (Sundays, 2–4:30); and November 1 to April 1, 10 a. m.–4 p. m. (Sundays 2–4).—Ed.

To Reach the Garden take Broadway (B.R.T.) Subway to Prospect Park Station; Interborough Subway to Eastern Parkway-Brooklyn Museum Station; Flatbush Avenue tro'ley to Empire Boulevard; Franklin Avenue, Lorimer Street, and Tompkins Avenue trolleys to Washington Avenue; St. John's Place trolley to Sterling Place and Washington Avenue; Union Street and Vanderbilt Avenue trolleys to Prospect Park Plaza and Union Street.

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